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ANTERO-POSTERIOR MOVEMENTS OF THE TEETH BETWEEN TWO AND TEN YEARS*

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THE movement of the teeth in the jaws, as a result of growth of head and face, eruption of teeth, or extraneous pressure, acting separately or in combination, is a phenomenon of common occurrence and general recognition. Detailed studies treating of changes in the dental arches caused by such movements are those by Colyer ('20), Franke ('21), Brash ('24, '28), Lewis and Lehman ('29), Hellman ('33), Smyth and Young ('32) and Goldstein and Stanton ('35). Of this group, however, considering the dental arches proper, *without reference to the head,* the *direction* of growth has been dealt with specifically only by Franke, Colyer, and Brash.

That such growth occurs, within the specific area of the dental arches, is abundantly attested to by the observation of changes of relationship between the teeth of the two jaws, the shifting of distances between teeth in the same jaw, and the increase or decrease in horizontal overbite due to variability in growth rate in either one or both arches.

The great obstacle to a quantitative investigation of growth-direction has been the apparently insurmountable difficulty of determining a point or points in the arches which would not change in position with growth.

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In other words, since a fixed point appeared essential in order to relate the dentitions at various ages, and such a stable base could not apparently be ascertained during the process of growth, an absolute or quantitative account of direction and movement of the teeth seemed quite impossible.

Brash ('28, p. 399) flatly states, with reference to forward and backward movement of the cheek teeth, that "there is absolutely no means of determining by measurement what is happening in this region."

Mention was made, however, that Franke, Colyer, and Brash had contributed to the problem of direction of growth in the alveolar arches. Franke used the first permanent molars as a base upon which relationships were made and modes of growth observed. The assumption was made, apparently, that the first permanent molars were stable, especially with regard to the dentition anterior thereto. It may suffice for the moment to point out that there was actually no foundation for this assumption of fixity in the first molar region. Indeed, Brash ('28, p. 493) states in this connection, as a result of his work on the growth of the mandible in madder-fed pigs, that "The first permanent molar cannot any longer be looked upon as a fixed point in any sense from which to measure or superimpose the alveolar arches. Its position, like that of any other point in the arches, is relative only."

Colyer related his dentures across the most anterior points of the central incisors. This procedure, however, is liable to essentially the same objection noted in the discussion of Franke's method; the incisors are no more stable than the molars.

The mode of tooth movement has been studied by Brash in another manner, namely, by noting in madder-fed pigs, "first, the distribution of new bone in the walls of the alveoli, made possible by the pigmentation of the new bone due to madder feeding; (and) second, in the actual relation of the new white inner edge of the alevolar border to the original red inner edge which is clearly visible below it."[1]

The conclusions of these authors will be referred to later in our study.

PRESENT STUDY

The method employed in the present study is an adaptation of that reported by F. L. Stanton ('22).[2] The latter was devised primarily to enable the orthodontist to relate dentures being changed by orthodontic appliances. Upon an orthographically projected (5 times enlarged) picture of the dentition, taken at the gingival margins of the teeth labially

[1] *loc. cit., p.* 399.

[2] See Stanton, F. L. and R. H. Hanau (1915), Fish, G. D. (1917), and Stanton, F. L., G. D. Fish, and M. F. Ashley-Montagu (1931). Full titles to these papers are given in the bibliography.

and lingually, and at the contact points proximally and distally, the geometrical center of the whole dentition is located. The foci of measurement are the centers of each tooth, which in each instance is merely the most centrally situated point in the tooth outline. An axis is then assumed through this center of the dentition, which is consequently corrected according to a formula devised by Fish by which it becomes an axis most nearly symmetrical in relation to the denture involved.

The details for method of projection and determining the center of dentition and axis must be referred to the papers already mentioned by Stanton and his collaborators.

Now, possessing a map (as the projected dentitions are called) of any given case of malocclusion, and a map of proper occlusion of this individual, the orthodontist can ascertain by relating the two upon center and axis, the minimal changes necessary in each tooth in order to attain the proper occlusion. Moreover, the direction and extent of tooth movement thereby become evident and measurable.

A method for determining the proper occlusion in any given case of malocclusion has also been propounded,[3] but this matter need not concern us in the present instance.

The question naturally arises as to the validity of this method of relating dentures by geometrical centers and axes of least asymmetry. The answer, justifying its tenability, has been made by Fish, an engineer, and in substance is thus:

> In the absence of extraneous forces, there is apparently no cause for displacement of the denture as a whole with respect to the skull. Expressing this postulate in terms of the Theory of Least Squares, it may be stated as a criterion that if a certain normal configuration be converted by forces acting among the teeth alone (induced by orthodontic appliances) into a certain different configuration, then the position of the new configuration with respect to the other will be such that the sums of the squares of displacement of the several tooth centroids will be the minimum possible.[4]

A detailed mathematical proof follows this contention.

It must be clearly understood that the denture center-axis method of relating dental arches is based on the assumption that the forces moving the teeth are initiated by orthodontic appliances, and therefore

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[3] Stanton, F. L., Arch predetermination and a method of relating the predetermined arch to the malocclusion, to show the minimum tooth movement. *Internat. J. Orth.*, v. 8, no. 12, 1922, pp. 757-778.

[4] This statement occurs in personal correspondence, and is not published. It appears, however, in different form in the papers by Fish, *loc. cit.*

must be *internal*. In other words, although the pressure exerted originates from the appliances, the movements, or actions and reactions, are *in and among the respective teeth only;* the teeth move merely in relation to each other. The dentition *as a whole* therefore, could neither be translated nor rotated. It is not as if the whole dentition was attached to a moving train, wherein the forces involved would obviously be external to the dentition, and the whole denture could then be moved as a unit in the same direction. And since the actions and reactions are entirely within the dentition proper, the net result of orthodontic treatment would necessarily be a change merely in form of the denture, the geometrical center of the dentition remaining virtually unchanged.

Now, it was realized that the *growth* forces affecting the dentition were external to the dentition. Not only does the dentition as a whole move with reference to the head, as an integral part thereof, and in correspondence with the growth downward and forward of the face, but it can scarcely be doubted that the alveolar arches proper are affected by growth of the various parts of the face and head: e.g., the maxillae, malars, palate, etc. Yet, just what the growth forces are, or even how growth of the various parts of the face and head influence the growth *within* the alveolar arches, to our knowledge, are quite unknown. Moreover, the alveolar area is rather a limited one, and absolute changes due to growth (increase or decrease in tissue)are not very great even over considerable periods of time.

It seemed to the writers, therefore, in view of the lack of knowledge concerning growth forces as such, and the suggestion that the external forces affecting the dentition were not large, that on the whole, and considering changes in the dental arches only without reference to the head, the method elaborated for relating dentures treated for malocclusion could be substantially applied to the study of movements among the teeth when no orthodontic treatment was involved.

A number of experiments were attempted to test this hypothesis. These consisted of arbitrary movements of the teeth in such a manner as could conceivably occur as a consequence of growth, which were then checked to see if such movements actually occurred according to the Stanton-Fish map relationship method.

The procedure was as follows. Assuming that the canine teeth had moved back 3 mm., pencil marks were made at this distance behind the centers of the respective cuspids. This new dentition, comprising teeth not moved and those moved, was thereupon transferred to

another sheet of paper, and a new geometrical center of denture and another axis were calculated according to this changed map. The maps, it may be mentioned, were made on transparent paper.

The two maps, original and changed, were then related according to their respective centers of dentition and axes. If the method of map relationship was valid, the teeth, represented by their centers, moved and not moved, should *coincide* in the two maps. If correspondence did not occur in teeth or centers of dentition and axes, the deviations in each case would essentially indicate the error involved in the attempt to depict movements induced by growth rather than by appliances.

It may be mentioned that the front and back movements observed were average ones, i.e., a line was drawn between corresponding teeth on each side of the arch and the various movements measured along the axis midway between the teeth (figure 1). Also of moment is the

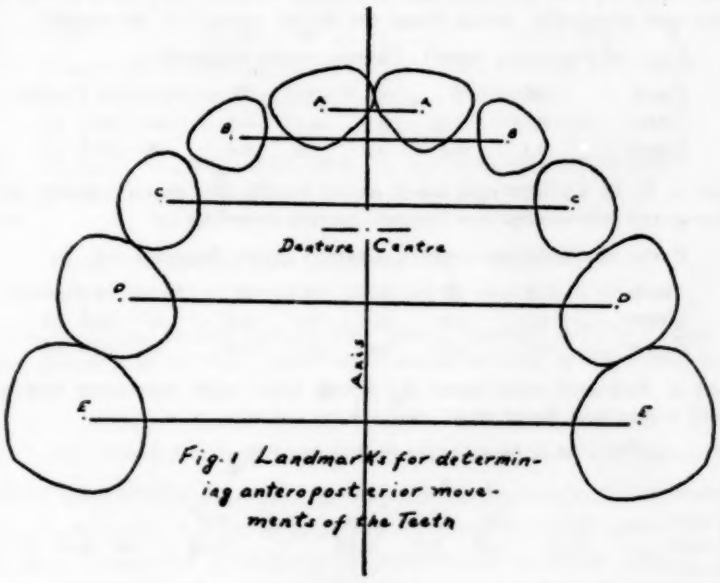


FIGURE 1

fact that the same number and kind of teeth were always counted when the denture centers and axes were calculated in maps of the same individual at different ages.

The results of the experiments follow.

Test 1. All of the upper teeth (10) were moved forward 1.0 mm., the lower (10) kept stationary.

Error of prediction[5] *(in mm.)*:

Denture center displaced 0.5

All upper and lower teeth 0.25 back of predicted position

This test, therefore appears a failure, and was actually anticipated as such. With all teeth of one denture moving forward, and the whole dentition of the other jaw remaining still, the denture center in the altered map must necessarily be located forward one half the entire translation, and the movements portrayed by map relationship would consequently show half of the predicted motion in the moving arch and the other moiety of movement in the stationary jaw.

Although it is conceivable that the whole dentition in one arch could move forward while all the teeth in the other arch remained quiescent, it scarcely seems probable that such activities would occur often, if at all. In any event, the method would not hold true for movements of this type.

Test 2. C, D, and E,[6] right and left sides in each jaw, were moved as a unit 2.0 mm. outwardly, swung round the mesial contact of the cuspids.

Error of Prediction (mm.): Denture center displaced 0.4

Teeth	*A*	*B*	*C*	*D*	*E*	*Predicted Position*
Upper	0.35	0.35	0.3	0.3	0.3	*all back of*
Lower	0.5	0.4	0.4	0.0	0.2	*all back of*

Test 3. C, D, E, right side, lower moved bucally and upper lingually so that one fossa-cusp relationship was jumped, causing cross-bite.

Error of Prediction (mm.): Denture center displaced 0.1

Teeth	*A*	*B*	*C*	*D*	*E*	*Predicted Position*
Upper	0.1	0.1	0.1	0.0	0.0	*all back of*
Lower	0.1	0.05	0.0	0.0	0.0	*all back of*

Test 4. Extracted right lower E; moved lower right permanent first molar forward 2 mm. and lower right cuspid back 1.0 mm.

Error of prediction (mm.): Denture centroid displaced 0.1

Teeth	*A*	*B*	*C*	*D*	*E*	*6*	*Predicted Position*
Upper	0.0	0.0	0.0	0.0	0.0	0.0	
Lower	0.15	0.1	0.1	0.05		0.15	*all back of*

[5]The error of prediction is the discrepancy between the predicted location of the teeth and their actual situation, when old and changed dentures are related on their respective denture centers and axes; e.g., a tooth is moved forward 2.0 mm. (prediction), whereas actual movement shown by map relationship is 1.8 mm. forward. The error would be 0.2 mm. back of predicted position.

[6]See figure 1 for explanation of characters.

Test 5. Upper incisors (4) moved forward 4 mm; lower incisors (4) moved back 2 mm.

Error of Prediction (mm.): Denture centroid displaced 0.4

Teeth	*A*	*B*	*C*	*D*	*E*	*6*	*Predicted Position*
Upper	0.45	0.5	0.3	0.3	0.4		*all back of*
Lower	0.4	0.5	0.3	0.25	0.3	0.15	*all back of*

Test 6. Lower central incisors (2) moved back 2.0 mm; lower lateral incisors (2) moved back radially 1.0 mm.

Error of Prediction (mm.): Denture centroid displaced 0.3

Teeth	*A*	*B*	*C*	*D*	*E*	*6*	*Predicted Position*
Upper	0.1	0.15	0.0	0.1	0.15		*all in front of*
Lower	0.2	0.15	0.15	0.2	0.2	0.2	*all in front of*

Test 7. Permanent incisors (8) substituted for deciduous incisors (8); 4 deciduous cuspids moved distally to close spaces back of these teeth. Permanent lower centrals consequently overlapped.

Actual movements were (mm.):

TEETH		RIGHT SIDE	LEFT SIDE
Upper	A	1.6 buccally; sl. back	0.5 buccally; sl. forward
	B	2.2 buccally; sl. back	2.0 buccally
	C	0.65 backward	0.6 backward
Lower	A	0.4 mesially; sl. back	0.25 forward; sl. buccal
	B	0.9 buccally	1.0 buccally
	C	0.5 backward	0.5 back; sl. buccal

Error of prediction (mm.): Denture center displaced 0.0

All teeth (20) of new map fell precisely on those of old map.

Test 8. Upper central incisors (2) moved together 2.5 mm; upper right cuspid moved back 1.0 mm; upper right permanent first molar moved forward 2.0 mm.

Error of prediction (mm.): Denture center displaced 0.0

All teeth (20) of new map fell precisely on those of old map.

The above comprise all the experiments attempted. It was felt that others could not be appreciably different in kind, and that under the same or similar conditions or movements as those already noted, there would necessarily result identical or very similar types of errors.

The experiments appear to indicate that in certain types of movements, especially those which would seem unlikely to occur, or to occur but rarely, under normal conditions of health, (e.g. Tests 1, 2, and 5), the method of map relationship by center of denture and axis of least

asymmetry was not altogether trustworthy. On the other hand, it seems to the authors that the experiments as a group did demonstrate an essential feasibility for use in determining direction and extent of movements of the teeth under circumstances simulating growth. To be sure, it is also plain that intelligent caution will have to be exercised in the interpretation of the data.

Further evidence supporting our contention of the substantial veracity of the method, may be seen from a brief consideration of the average error involved.

All the errors of prediction occurring in each dentition were summated. The average errors were then obtained by dividing these sums by half the total number of teeth reckoned in the establishment of denture center and axis. It will be recalled that the extent of deviation from predicted location was ascertained on the axis, practically a midpoint between the right and left sides of the dental arch. Hence the "weighting" or division of the total number of teeth by two, thereby achieving a median value obviously necessary under the circumstances.

The data are presented below. It is seen that the amounts of error between predicted and actual positions of the teeth, considered in toto, and including even the extreme and probably rare cases, are very slight indeed, 0.171 mm. in the upper arch, and 0.183 mm. in the lower.

Calculation of Total Error in Each Dentition between Predicted and Actual Location of Teeth (mm.)

	TESTS								
	1	2	3	4	5	6	7	8	TOTALS
Upper Dentition (80 teeth)	2.5	1.6	0.3	0.0	1.95	0.5	0.0	0.0	6.85
Lower Dentition (84 teeth)	2.5	1.5	0.15	0.55	1.9	1.1	0.0	0.0	7.70

$$\frac{6.85 \text{ mm.}}{80/2} = 0.171 \text{ mm. Average Error in Upper Arch}$$

$$\frac{7.70 \text{ mm.}}{84/2} = 0.183 \text{ mm. Average Error in Lower Arch}$$

It might also be recalled that the *direction* of movement was generally correct even when a greater or less error existed between predicted and actual amounts of movement.

MATERIAL

The present study is based upon the dentitions of 183 children attending the Division of Child Research, College of Dentistry, New York University. Their ages range from 2-10 years. Observations were carried on over a span of 2 to 6 years, and dental impressions (plaster of paris, excepting a few in compound) were obtained at yearly intervals.

It is obvious that two dental casts were necessary in each case in order to observe movements during a single year.

Children with no previous orthodontic treatment only were included in the study; dentitions with space retainers were among those excluded except where their use was confined to one jaw only, in which case the dentition of the opposite jaw was utilized.

The material comprises cases with normal and abnormal occlusion, and has been so divided in the presentation.[1] Classification of normal and abnormal occlusion was made according to the usual practice of the orthodontist; border-line cases, of course, might be placed in either category by different observers.

Cognizance was taken of forward and backward movements in each jaw with respect to deciduous-deciduous, deciduous-permanent, and permanent-permanent teeth. The factor of sex was not considered for lack of sufficient number of cases, although mention may be made that our impression after mulling through the data is that no essential difference in direction or extent of tooth-movement occurred between males and females.

DIRECTION OF MOVEMENT

Upper dentition

(a). Non-movement—In this category, besides complete absence of movement, are placed changes of 0.1 and 0.2 mm., forward or backward. Such movements, it was felt, were scarcely appreciable, and were so slight that they might be due, despite painstaking care, to errors of

[1]Note: When the first dental cast manifested normal occlusion, and a year following it was abnormal, any movement of teeth within this interim was classified as of abnormal occlusion; when the first was abnormal, and the following year it had become normal, movement was considered as of the normals. Relatively few cases occurred in this manner: most cases, when normal one year, were normal the following year, and vice versa.

TABLE 1A

Percentage of Various Teeth Moving Forward, Backward or Not At All According to Ages of Children, Upper Dental Arch, Normal Occlusion

AGE (*Yrs.*)	MOVEMENT	A-A %	B-B %	C-C %	D-D %	E-E %	6-6 %
		(14)[1]	(14)	(12)	(14)	(10)	
2-3	None[2]	57	50	83	64	50	
	Forward[3]	14	21	..	14	50	
	Backward[4]	29	29	17	21	..	
		(25)	(25)	(25)	(25)	(22)	
3-4	None	60	64	64	72	59	
	Forward	..	4	8	12	32	
	Backward	40	32	28	16	9	
		(35)	(35)	(37)	(37)	(37)	(1)
4-5	None	57	54	62	59	35	100
	Forward	17	23	16	30	51	
	Backward	26	23	22	11	14	
		(21)	(21)	(23)	(23)	(23)	(2)
5-6	None	52	57	61	57	65	100
	Forward	14	10	4	30	30	
	Backward	33	33	34	13	4	
		(15)	(12)	(19)	(19)	(19)	(5)
6-7	None	20	50	63	58	58	80
	Forward	7	8	5	21	26	0
	Backward	77	41	31	20	16	20
		(7)	(7)	(8)	(8)	(8)	(7)
7-8	None	29	42	38	63	75	43
	Forward	43	14	12	12	..	14
	Backward	29	43	50	25	25	43
		(5)	(5)	(4)	(5)	(4)	(5)
8-9	None	20	40	100	60	50	40
	Forward	60	40	...	..	25	20
	Backward	20	20	...	40	25	40
		(3)	(3)	(3)	(3)	(3)	(3)
9-10	None	33	..	67	67	67	33
	Forward	33	33	..	33	..	33
	Backward	33	67	33	..	33	33

[1]Figures in brackets refer to number of cases.
[2]Includes 0.1 and 0.2 mm. movements in either direction.
[3]Excluding 0.2 mm. and less.
[4]Excluding 0.2 mm. and less.

TABLE 1B

Percentage of Various Teeth Moving Forward, Backward or Not At All According to Ages of Children, Upper Dental Arch, Abnormal Occlusion

AGE (*Yrs.*)	MOVEMENT	A-A %	B-B %	C-C %	D-D %	E-E %	6-6 %
		(9)[1]	(9)	(8)	(9)	(4)	
2-3	None[2]	..	11	63	44	50	
	Forward[3]	33	44	12	22	..	
	Backward[4]	66	44	25	33	50	
		(21)	(22)	(22)	(22)	(21)	
3-4	None	43	45	50	55	57	
	Forward	10	19	18	27	38	
	Backward	47	36	32	18	5	
		(25)	(28)	(30)	(29)	(30)	
4-5	None	44	39	50	41	23	
	Forward	32	28	37	48	74	
	Backward	24	33	13	10	3	
		(16)	(20)	(26)	(26)	(26)	(1)
5-6	None	44	50	50	46	30	...
	Forward	19	20	23	46	58	100
	Backward	37	30	27	8	12	...
		(19)	(12)	(28)	(27)	(28)	(13)
6-7	None	37	33	68	44	46	31
	Forward	37	33	11	19	28	23
	Backward	26	33	22	37	25	46
		(30)	(12)	(35)	(32)	(36)	(31)
7-8	None	37	33	43	59	64	74
	Forward	34	42	11	13	11	13
	Backward	30	25	46	28	25	13
		(29)	(18)	(23)	(21)	(27)	(27)
8-9	None	48	50	61	52	56	56
	Forward	42	44	17	19	22	33
	Backward	10	6	21	29	22	11
		(13)	(13)	(10)	(8)	(11)	(14)
9-10	None	69	46	60	63	45	43
	Forward	23	23	20	25	27	28
	Backward	8	31	20	12	27	29

[1]Figures in brackets refer to number of cases.
[2]Includes 0.1 and 0.2 mm. movements in either direction.
[3]Excluding 0.2 mm. and less.
[4]Excluding 0.2 mm. and less.

measurement or even of projection of the denture. Discounting the 0.1—0.2 mm. movements should minimize these possible errors and give a more reliable picture of actual changes in position of the teeth.

There is seen (tables 1a and 1b) in all age intervals and among all the teeth of the dentition, a substantial percentage of cases without movement. This stability is apparent in the dentitions both with normal occlusion and malocclusion. Indeed, in most instances the incidence of non-movement appears equal to or exceeds the combined frequency of forward and backward changes.

A decrease in this stability, especially in the teeth anterior to the molars (deciduous), is noted (fig. 2) between the ages 5 and 8 years, a condition probably due to the acceleration of alveolar growth at this time.[8] In fig. 2 can also be more clearly seen that stability is more evident in dentitions with normal than with abnormal occlusion.

(b). Antero-posterior movement—Normal and abnormal dentitions each exhibit (tables 1a and 1b) anterior and posterior movements in all the respective teeth. At the same time it is seen that the incidence of forward and backward movements differs appreciably between the different teeth and at the various age intervals.

Considering the normal dentitions first, we note a definitely greater percentage of backward movement in the teeth anterior to the molars (deciduous), at all ages except the last two (8-9 and 9-10). Curiously enough, the deciduous molars reverse the above trend; during the early years, from 2 to 7, the direction of movement is preponderantly forward, after which it is somewhat more frequently backward. The paucity of permanent first molars scarcely permits comment on these teeth, although it is of interest to note that the trend toward backward movement here discernible appears likewise in the abnormals which contain a fairly representative series.

Movements of teeth in the abnormal dentitions appear essentially similar to those in the normal. Backward movements are more prevalent among the incisors and cuspids until the 6-7 year interval, after which the anterior direction equals or exceeds the backward. A similar situation was noted in the normals except that the change in trend from posterior to anterior occurred at the 8-9 year stage.

As in the normals, the temporary molars manifest a greater frequency of forward movement until the seventh year, after which the

[8]Acceleration of alveolar growth within this age period has been noted by Young and Smyth ('32), Goldstein and Stanton ('35), and others.

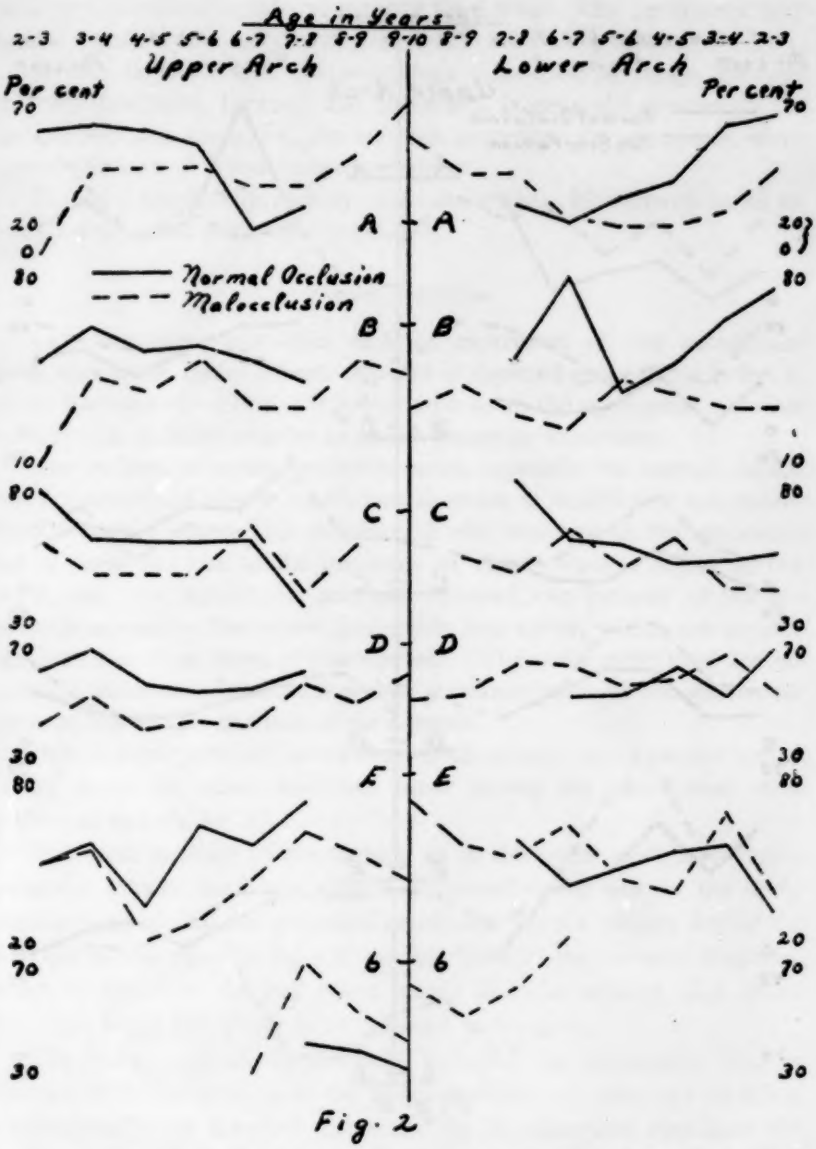


FIG. 2. PERCENTAL DISTRIBUTION OF CASES WITH NORMAL AND ABNORMAL OCCLUSION, RESPECTIVELY, MANIFESTING NO ANTEROPOSTERIOR MOVEMENT (0-0.2 MM.) IN THE SEVERAL TEETH (UPPER AND LOWER DENTITIONS)

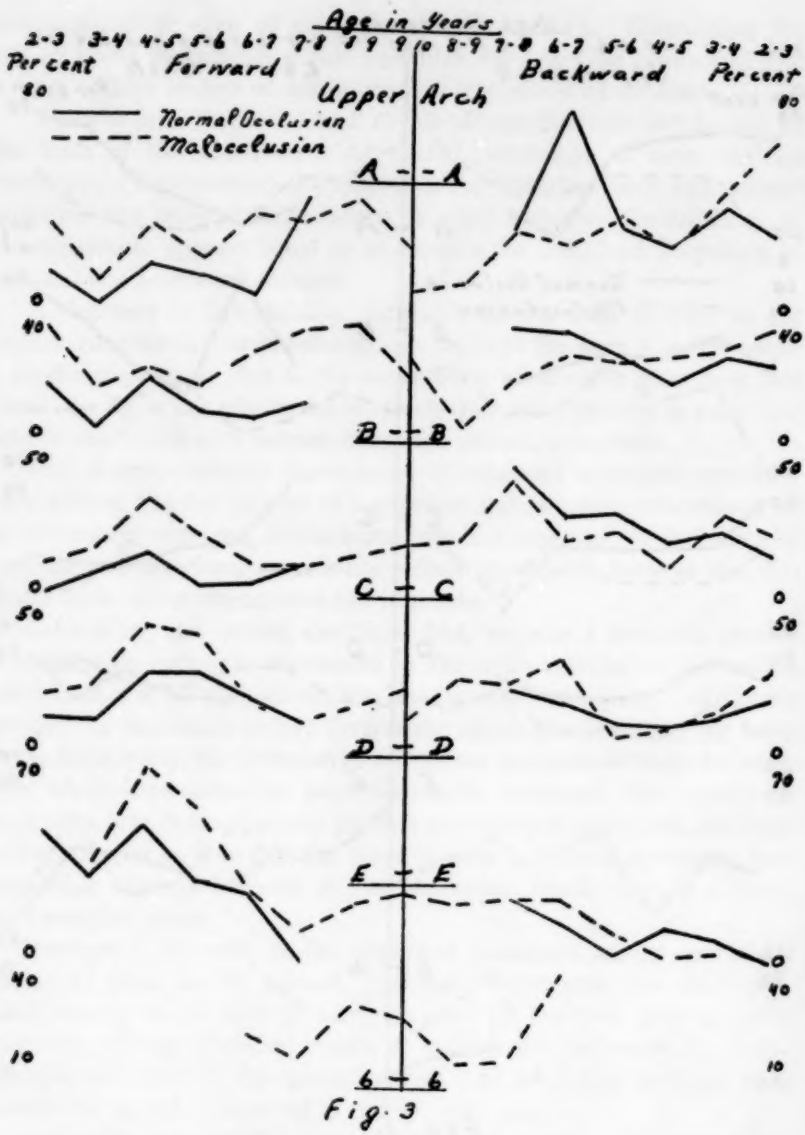


FIG. 3. PERCENTAL DISTRIBUTION OF CASES WITH NORMAL AND ABNORMAL OCCLUSION MANIFESTING, RESPECTIVELY, FORWARD AND BACKWARD MOVEMENTS IN THE SEVERAL TEETH ACCORDING TO AGE (UPPER DENTITION)

backward direction equals or exceeds the former. The permanent first molars seem about equally susceptible to forward as to backward shifts.

It may be noted that the percentage difference, or range, between the two directions, forward and backward, is generally greater in the normal occlusion cases; i.e., the normals, more than the abnormals, show a predominance of one direction-movement.

Figure 3 graphically portrays the tabular data. Movements based on less than six cases were not represented.

Lower dentition

(a). Non-movement—The lack of movement of the mandibular teeth appears in tables 2a and 2b, and is depicted graphically in fig. 2. As in the upper dentition, the lower teeth at all the ages noted manifest considerable stability relative to antero-posterior movement.

The incisors of normal occlusion cases, especially the centrals, manifest a marked and almost continuous decrease of stability or non-movement from 2-7 years. This condition is also observed in the abnormals but in these the rise in the incidence of non-movement begins at 6-7 years, one year before the normals. Indeed, the incisors of the abnormals appear on the whole perceptibly less stable, within comparable age intervals, than those of the normals. The teeth other than the incisors in abnormal occlusion, however, manifest trends of non-movement more or less similar to those of the normals.

(b). Antero-posterior movement—Both anterior and posterior movements, as in the upper dentition, occur among the mandibular teeth (tables 2a and 2b, fig. 4).

The teeth anterior to the molars, as in the upper arch, manifest a generally greater tendency toward backward movement in the early years in both normal and abnormal dentitions. Yet the cuspids during the 5-6 year period show by far a larger incidence of the forward direction, which continues to the end (9-10 years) and the incisors, also, about 6-7 years begin exhibiting more forward movements.

The molar teeth of the normals, including the permanent first, in contrast with the situation in the upper dentition, at *every age* manifest predominantly the forward direction. In the abnormal dentitions the deciduous second molar also regularly moves forward more frequently, albeit to a somewhat less degree than in the normals; the permanent first molar likewise tends to the anterior direction.

TABLE 2A

Percentage of Various Teeth Moving Forward, Backward or Not At All According to Ages of Children, Lower Dental Arch, Normal Occlusion

AGE (*Yrs.*)	MOVEMENT	A-A %	B-B %	C-C %	D-D %	E-E %	6-6 %
		(14)[1]	(14)	(12)	(14)	(11)	
2-3	None[2]	64	78	58	64	18	
	Forward[3]	14	14	8	21	82	
	Backward[4]	21	7	33	14	..	
		(27)	(27)	(27)	(27)	(25)	
3-4	None	59	67	56	44	48	
	Forward	19	11	33	48	40	
	Backward	23	22	11	7	12	
		(34)	(33)	(35)	(35)	(35)	(1)
4-5	None	38	48	54	54	46	100
	Forward	9	9	12	29	49	...
	Backward	53	42	34	17	5	...
		(19)	(21)	(23)	(22)	(23)	(2)
5-6	None	32	38	61	45	39	100
	Forward	15	24	30	50	57	...
	Backward	53	38	9	5	3	...
		(13)	(11)	(16)	(16)	(15)	(4)
6-7	None	23	82	63	44	33	75
	Forward	46	9	37	56	67	25
	Backward	30	9	..	..	..	..
		(7)	(6)	(7)	(5)	(6)	(3)
7-8	None	29	50	86	60	50	67
	Forward	29	17	14	20	33	33
	Backward	43	34	..	20	17	..
		(5)	(5)	(4)	(3)	(5)	(5)
8-9	None	60	40	100	67	80	80
	Forward	40	40	..	..	20	20
	Backward	..	20	..	33	..	..
		(2)	(2)	(2)	(2)	(2)	(2)
9-10	None	..	50	50	100	100	100
	Forward	50	..	50	...	...	...
	Backward	50	50	..	...	...	...

[1]Figures in brackets refer to number of cases.
[2]Includes 0.1 and 0.2 mm. movements in either direction.
[3]Excluding 0.2 mm. and less.
[4]Excluding 0.2 mm. and less.

TABLE 2B

Percentage of Various Teeth Moving Forward, Backward or Not At All According to Ages of Children, Lower Dental Arch, Abnormal Occlusion

AGE (*Yrs.*)	MOVEMENT	A-A %	B-B %	C-C %	D-D %	E-E %	6-6 %
		(9)[1]	(9)	(9)	(9)	(4)	
2-3	None[2]	44	33	44	44	25	
	Forward[3]	22	22	11	22	75	
	Backward[4]	33	44	44	33	..	
		(22)	(22)	(22)	(22)	(22)	
3-4	None	27	32	45	59	59	
	Forward	23	23	19	32	32	
	Backward	50	45	36	9	9	
		(28)	(26)	(28)	(28)	(28)	
4-5	None	21	38	64	50	29	
	Forward	15	8	14	29	50	
	Backward	64	53	22	22	21	
		(24)	(16)	(23)	(23)	(23)	(2)
5-6	None	21	44	52	48	35	50
	Forward	42	12	31	39	43	50
	Backward	37	44	17	13	21	..
		(25)	(20)	(27)	(25)	(27)	(11)
6-7	None	24	25	67	56	56	73
	Forward	56	25	22	24	33	27
	Backward	20	50	11	20	11	..
		(34)	(27)	(34)	(30)	(35)	(28)
7-8	None	41	30	50	57	43	54
	Forward	18	26	27	20	32	22
	Backward	41	45	24	23	26	25
		(24)	(22)	(21)	(20)	(23)	(23)
8-9	None	42	41	57	45	48	43
	Forward	37	27	24	30	39	39
	Backward	21	32	19	25	13	17
		(9)	(9)	(4)	(7)	(9)	(9)
9-10	None	56	33	..	43	66	55
	Forward	11	33	50	14	22	33
	Backward	33	33	50	43	11	11

[1]Figures in brackets refer to number of cases.
[2]Includes 0.1 and 0.2 mm. movements in either direction.
[3]Excluding 0.2 mm. and less.
[4]Excluding 0.2 mm. and less.

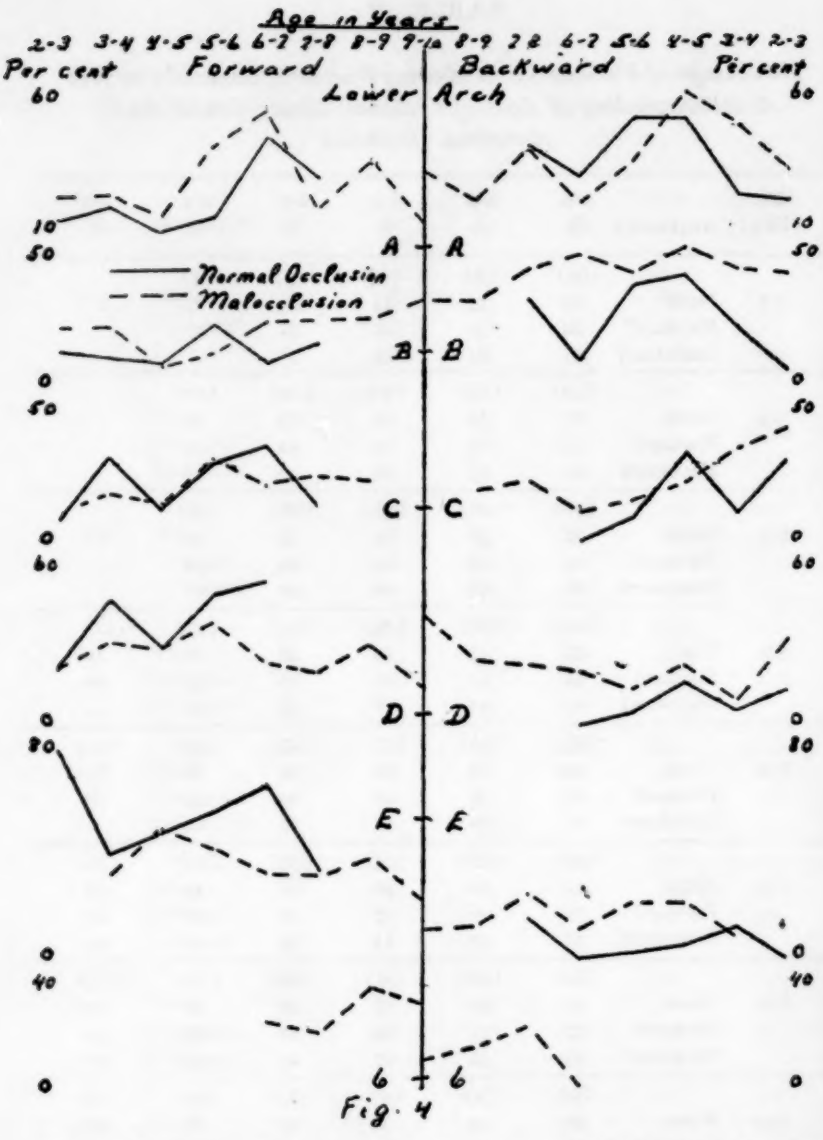


FIG. 4. PERCENTAL DISTRIBUTION OF CASES WITH NORMAL AND ABNORMAL OCCLUSION MANIFESTING, RESPECTIVELY, FORWARD AND BACKWARD MOVEMENTS IN THE SEVERAL TEETH ACCORDING TO AGE (LOWER DENTITION)

Transition from deciduous to permanent teeth

Consideration of movements of teeth with respect to changes in dentition from deciduous to permanent, is confined to the incisors only; data for the other teeth were too meager to permit analysis.

The question whether the permanent teeth occupy the same positions as the temporary, is obviously a pertinent one, and has received much attention by Franke, Brash, and others.

TABLE 3

Percentage of Total Number of Cases with No Movement (0-0.2 mm.) According to Dentition

		Upper						Lower					
		D		M		P		D		M		P	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
A—A	N.	(80)	60	(15)	13	(15)	20	(69)	58	(18)	17	(20)	30
	Ab.	(60)	35	(21)	24	(66)	53	(48)	31	(17)	18	(78)	32
B—B	N.	(90)	57	(6)	13	(10)	20	(88)	61	(8)	37	(9)	44
	Ab.	(76)	43	(13)	23	(29)	52	(62)	37	(21)	10	(50)	36

D—Deciduous; M—Mixed (deciduous to permanent); P—Permanent.
N—Normal; Ab.—Abnormal

In table 3 we have the percentages of non-movement, *irrespective of age,* occurring in deciduous, mixed (deciduous to permanent), and permanent incisors; the results are considered also with regard to normal and abnormal occlusion, upper and lower arches.

Some very interesting and not unexpected trends are noted. More than half of all *deciduous* incisors of normal occlusion cases exhibit lack of movement, whereas the *mixed* dentition (deciduous to permanent incisors) manifests, comparatively, a remarkably low incidence of stability. A somewhat greater percentage of non-movement occurs in the *permanent* incisors, but these are still much less stable than the deciduous.

Both upper and lower incisors, central and lateral, are affected in the above manner, although the mixed and permanent lower incisors are seen to be appreciably more stable than the upper teeth in the like categories.

The incisors of abnormal occlusion cases show both similar and quite dissimilar tendencies. Here too is discernible stability for a large percentage of *deciduous* incisors; the percentages are much less, however, than in the normals; i.e., the deciduous incisors of abnormal cases are more mobile than those of normals, an observation noted before as a general tendency. Moreover, as in the normals, there is a sharp decrease of stability in the transition from deciduous to permanent incisors, although here, especially in the upper arch, the incidence of stability seems greater than in normal occlusion. But in clear contrast with the situation in normal occlusion, the *permanent* incisors of abnormal cases manifest a sharp reversion to extensive stability, the incidence of non-movement being as great as, or exceeding, the proportion observed in the deciduous teeth.

In short, whereas the deciduous incisors, irrespective of age and relative to antero-posterior movement, appear very often quiescent,

TABLE 4

Percentage of Anteroposterior Movements of Teeth in Deciduous, Deciduous to Permanent, and Permanent Dentitions (over 0.2 mm.)

		Upper				Lower			
		Normal		Abnormal		Normal		Abnormal	
		F.	B.	F.	B.	F.	B.	F.	B.
		(32)		(39)		(29)		(33)	
	D.	22	78	36	64	31	69	30	70
		(13)		(16)		(15)		(14)	
A—A	M.	23	77	38	62	—	100	14	86
		(12)		(31)		(14)		(53)	
	P.	58	42	77	23	71	29	66	34
		(39)		(43)		(34)		(39)	
	D.	30	70	40	60	29	71	26	74
		(5)		(10)		(5)		(19)	
B—B	M.	40	60	70	30	40	60	16	84
		(8)		(14)		(5)		(32)	
	P.	50	50	57	43	60	40	56	44

Figures in brackets refer to total cases.
D—Deciduous; M—Mixed (deciduous to permanent); P—Permanent.
F—Forward; B—Backward.

movement forward or backward becomes predominent in, and probably as a consequence of, the transition from temporary to permanent teeth. This mobility, somewhat lessened, appears to continue a few years after the eruption of the permanent incisors in cases with normal occlusion whereas an extensive reversion to stability (0-0.2 mm.) takes place in the abnormal cases.

In Table 4 are presented the data concerning direction of movement in each type of dentition. Except for the lower central incisor of the "mixed" normals, where movement has been backward exclusively, both forward and backward movements are seen to occur between deciduous, mixed, and permanent incisors, respectively. The interesting result, however, is the greater tendency toward *forward* movement in the permanent incisors as contrasted with the dominance of backward movement in both the deciduous and mixed incisors.

More detailed attention will be given to the subject of transition from deciduous to permanent teeth later in our discussion.

EXTENT OF ANTERO-POSTERIOR MOVEMENT

A correlative of direction of movement must be the extent or amount of shift, consideration of which will now follow.

The extent of movement was not considered according to chronological age, in view of the fact that such division, and further subdivision by type of movement (forward and backward) and permanency of teeth, would have made the various series too small for dependable averages. Instead, the data were classified according to the Hellman stages,[9] which are based on stage of tooth eruption; larger and more representative series were thereby attained.

The average ages corresponding to the Hellman stages, as occurring in the present study, are given in Table 5. Each cast is counted separately, and therefore the number of cases here exceeds the numbers appearing in direction or amount of movement where two dental casts, it will be recalled, of a single individual were necessary for one observation of tooth movement.

As regards stage of tooth eruption, the children of the present study appear somewhat younger than do Hellman's (table 5). However, inasmuch as one stage may extend over a period of years in the

[9]Hellman, M., Growth of the face and occlusion of the teeth in relation to orthodontic treatment. *Internat. J. Orth.*, V. 19, no. 11, 1933.

TABLE 5

Average Ages of Children Corresponding to the Hellman Stages

HELLMAN STAGES	SEX	NORMAL OCCLUSION			MALOCCLUSION			HELLMAN'S DATA		
		No.	Aver. Age	S. D.	No.	Aver. Age	S. D.	No.	Aver. Age	S. D.
II A	Males	98	4.35	1.06	86	4.14	1.07	17	5.53	1.52
	Females	104	4.58	1.02	62	4.34	1.18	19	5.53	0.94
	Both sexes	202	4.47	...	148	4.22	...	..	...	...
II C	Males	...	...	...	...	...	...	13	7.69	1.94
	Females	...	...	...	...	...	...	15	6.67	0.60
	Both sexes	14	6.07	...	21	6.45	...	..	...	...
III A	Males	28	7.37	0.99	113	8.28	1.32	115	9.00	1.41
	Females	35	8.00	1.63	89	7.96	1.26	106	8.40	1.14
	Both sexes	63	7.72	...	202	8.14	...	...	...	...

II A, indicates the presence of deciduous second molars.
II C, indicates beginning of eruption of permanent first molars (eruption through gums of any one or two, regardless whether upper or lower).
III A, presence of permanent first molars (three or more).

same individual, the differences between the averages are probably due to the fact that examinations on the present children were begun at rather early ages, in order to trace developmental histories, whereas the Hellman group was more likely obtained as the children came for orthodontic observation or treatment.

It is of interest to note that the deciduous dentition is completed somewhat earlier in the abnormal occlusion cases. On the other hand, children with normal occlusion seem to get their permanent first molars earlier than do those with malocclusion. Regarding sex, the full complement of deciduous teeth, for both normal and abnormal occlusion, appear slightly earlier in the males.

The permanent first molars in normal occlusion, also seem to erupt earlier in the male, but the reverse occurs in abnormal occlusion, namely, the molars appear sooner in the female.

TABLE 6

Average Anteroposterior Movements of the Upper Teeth

HELLMAN STAGES	A-A			B-B			C-C	D-D	E-E	6-6
	D.	M.	P.	D.	M.	P.	D.	D.	D.	
Forward Movement (*mm.*) Normal Occlusion										
	(13)			(25)			(26)	(45)	(49)	
II A	0.26	...	...	0.27	...	...	0.21	0.23	0.34	...
	(1)	(1)		(4)			(4)	(10)	(11)	
II C	0.1	0.6	...	0.15	...	...	0.17	0.28	0.22	...
	(1)	(2)	(9)	(2)	(3)	(4)	(6)	(7)	(9)	(7)
III A	0.2	0.5	0.41	0.15	0.36	0.47	0.23	0.22	0.27	0.20
Abnormal Occlusion										
	(14)			(19)			(25)	(33)	(38)	
II A	0.59	...	...	0.44	...	...	0.34	0.38	0.40	...
	(4)	(1)	(1)	(5)			(8)	(12)	(14)	
II C	0.37	0.20	0.10	0.34	...	...	0.36	0.45	0.40	...
		(7)	(34)	(3)	(9)	(13)	(21)	(23)	(33)	(37)
III A	...	0.50	0.52	0.26	0.70	0.36	0.25	0.23	0.24	0.28
Backward Movement (*mm.*) Normal Occlusion										
	(49)			(42)			(32)	(21)	(16)	
II A	0.30	...	...	0.27	...	...	0.27	0.23	0.18	...
	(5)	(7)		(11)			(12)	(7)	(4)	
II C	0.28	0.90	...	0.43	...	...	0.36	0.28	0.40	...
	(2)	(4)	(6)	(1)	(3)	(5)	(15)	(12)	(10)	(15)
III A	0.60	0.97	0.31	1.1	0.86	0.36	0.36	0.30	0.30	0.30
Abnormal Occlusion										
	(33)			(30)			(22)	(15)	(10)	
II A	0.41	...	...	0.36	...	...	0.35	0.34	0.27	...
	(4)	(4)		(9)	(1)		(9)	(4)	(2)	
II C	0.40	0.87	...	0.53	0.60	...	0.32	0.20	0.20	...
	(1)	(8)	(22)	(5)	(3)	(10)	(57)	(38)	(42)	(40)
III A	0.10	0.52	0.31	0.26	0.50	0.43	0.32	0.32	0.32	0.26

Figures in brackets refer to number of cases.
D—Deciduous to deciduous.
M—Mixed, or deciduous to permanent.
P—Permanent to permanent.

UPPER AND LOWER DENTITIONS

In calculation of average movements changes of 0.1 and 0.2 mm. were included. The incisors were divided according to movements between deciduous, deciduous to permanent (mixed), and permanent teeth; too few permanent teeth had replaced the deciduous molars or canines to enable similar treatment with these.

Examining the data (tables 6 and 7) several items of considerable interest become evident. First is the observation that the amounts of anterior and posterior movements are almost in every instance greater in abnormal occlusion. Second, of the deciduous teeth the incisors, on the whole, move most extensively; the permanent first molars shift in position only very slightly in either direction. Third, no consistent differences in average movement appear in the several Hellman stages, except in the incisors, where the various stages signify a change from deciduous to permanent teeth. Fourth, no marked difference in amount of movement seems apparent between the forward and backward directions. Fifth, no distinctive differences in average movements between upper and lower dentitions appear in the tables. And sixth, the greatest amount of movement occurs in the incisors during the transition from deciduous to permanent teeth.

The point may be raised that the amounts of movement throughout appear very slight. This is undeniably true in a number of instances (0.2 mm., e.g.), and indeed would therefore seem to be important negative evidence. However, with all the teeth arranged contiguously in an arc, and confined as the whole arc is within comparatively narrow limits, a relatively slight amount of movement may become significant, especially wth reference to form, and consequently occlusion. The proper occlusion of the teeth depends on a harmonious relationship between the upper and lower dentitions; a deviation of half a millimeter even may be the difference between proper occlusion and malocclusion.

DISCUSSION

The problem of alveolar growth and tooth movement has probably been given more attention by Brash than by any other single individual. Systematizing and critically reviewing the extant literature on the subject, as well as stressing the need for further elucidation of the problem, he has contributed materially to this elucidation by important original

TABLE 7

Average Anteroposterior Movements of the Lower Teeth

HELLMAN STAGES	A-A			B-B			C-C	D-D	E-E	6-6
	D.	M.	P.	D.	M.	P.	D.	D.	D.	
Forward Movement (*mm.*)										
Normal Occlusion										
	(23)			(22)			(30)	(42)	(50)	
II A	0.26	...	...	0.28	...	...	0.27	0.32	0.38	...
	(1)		(2)	(3)	(1)		(10)	(15)	(15)	
II C	0.90	...	1.45	0.30	0.20	...	0.48	0.41	0.42	...
		(1)	(11)	(2)	(3)	(4)	(6)	(8)	(11)	(8)
III A	...	0.10	0.58	0.10	0.36	0.27	0.25	0.23	0.30	0.23
Abnormal Occlusion										
	(10)		(1)	(11)			(14)	(25)	(26)	
II A	0.38	...	0.30	0.34	...	...	0.34	0.32	0.42	...
	(1)	(1)	(2)	(5)			(12)	(12)	(14)	
II C	0.30	0.50	1.20	0.32	...	...	0.40	0.44	0.42	...
		(1)	(42)		(4)	(24)	(29)	(31)	(44)	(38)
III A	...	1.20	0.50	...	0.52	0.50	0.32	0.32	0.36	0.33
Backward Movement (*mm.*)										
Normal Occlusion										
	(36)	(6)	(1)	(44)	(1)		(41)	(25)	(15)	
II A	0.28	1.30	0.50	0.28	0.60	...	0.25	0.22	0.20	...
	(1)	(9)	(2)	(5)	(1)		(7)	(2)	(1)	
II C	0.10	1.01	0.30	0.38	2.50	...	0.20	0.20	0.10	...
	(1)	(2)	(4)	(1)	(1)	(5)	(9)	(7)	(7)	(5)
III A	0.20	0.35	0.30	0.20	0.30	0.40	0.13	0.17	0.18	0.18
Abnormal Occlusion										
	(28)	(5)		(38)			(33)	(20)	(18)	
II A	0.48	1.04	...	0.44	...	...	0.36	0.34	0.36	...
	(1)	(7)		(4)	(1)		(2)	(3)	(1)	
II C	0.90	0.74	...	0.15	1.00	...	0.55	0.36	0.20	...
		(3)	(28)	(1)	(16)	(22)	(24)	(27)	(27)	(22)
III A	...	0.20	0.48	0.30	0.83	0.43	0.37	0.31	0.27	0.30

Figures in brackets refer to number of cases.
D—Deciduous to deciduous.
M—Mixed, or deciduous to permanent.
P—Permanent to permanent.

research. Reference has already been made to his method of studying alveolar growth and tooth-movements. This was, in brief, by feeding madder to pigs, thereby inducing pigmentation in the skeleton and subsequently tracing the course of growth by observations on pigmented and unpigmented areas.

As a result of these investigations, or, rather, one of the many results thereof, the conclusion was reached that "the alveolar arches are in a constant state of change. Not only is there a constant upward growth.....but there is also a continuous movement of all the teeth in two other directions—buccal and proximal" ('28, p. 493). In the same paper he states that "Detailed study has..... convinced me that forward movement is a reality" (p. 400); this observation seemed especially applied to the "cheek teeth."

Considering proximal-distal movements only, the above conclusions as far as they go appear substantially corroborated in the preceding. But, although proximal movements have actually been observed, distal shifts were noted as well. Moreover, there were many instances when virtually no movement, or stability, did occur in the various teeth. This latter point, however, is essentially not contradictory to Brash's contention, for it is to be understood that when stability is cited in the present paper it is for a single age interval; whether any particular tooth remained stationary for several years could not be ascertained in most of the available material. In the relatively few cases which did afford 4 or 5 dental casts of the same individual, stability, when evident at the first age, did not persist to the last observation. It seems also to the writers that absolute stability of teeth rarely if ever occurs over a considerable lapse of time, surely not during the period of active growth.

Movements of the teeth, therefore, do not appear confined exclusively to one direction, but occur both forward and backward. Indeed, the direction may, and not infrequently does, differ among the several teeth of the same individual; or the direction of movement, even the incidence of stability, of the various teeth may be dissimilar in different individuals.

Brash also observed that the first permanent molar is not fixed, that "its position, like that of any other point in the jaws, is relative only" ('28, p. 493). That this was the case, the first permanent molar actually moving within the arch, was also observed in the present study. Yet here again it must be noted that an appreciable percentage of cases manifested practically no antero-posterior change during a specific time interval.

On the other hand, Brash's conclusion that anterior movement occurs in the molars would seem, according to our data (tables 1-2), substantially corroborated, at least to the extent that it is the more usual direction.

Colyer ('20) has depicted the deciduous and permanent dentitions of the same individual superimposed with the labial edges of the incisors of each coinciding. Brash, commenting on this figure ('28, p. 126) observes that "the molars appear.....to have moved forward *slightly*."

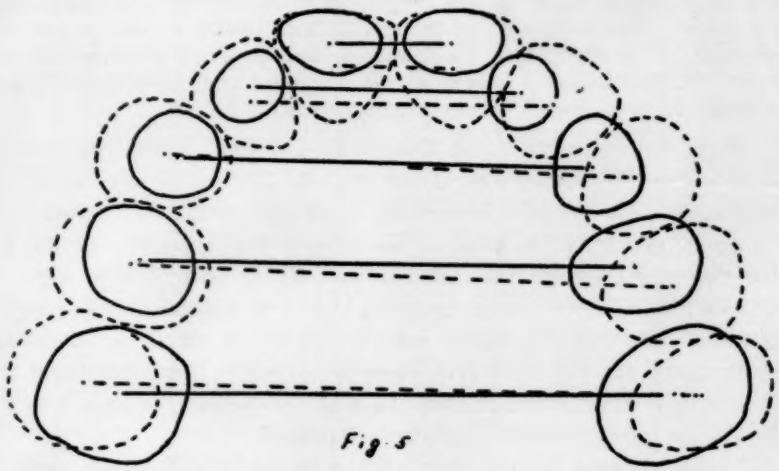


FIG. 5. FROM "A NOTE ON THE CHANGE IN THE DENTAL ARCH DURING CHILDHOOD," BY SIR FRANK COLYER. UPPER MILK AND PERMANENT DENTAL ARCHES OF THE SAME INDIVIDUAL SUPERIMPOSED (3 YEARS 10 MONTHS, CONTINUOUS LINE; 15 YEARS 5 MONTHS, BROKEN LINE: ENLARGED 2 TIMES)

Closer observation of Colyer's figure, reproduced in modified form in figure 5, reveals other interesting results. The figure has been modified merely to the extent of enlarging it and indicating deciduous and permanent teeth by continuous and broken lines, and by demarcating in each tooth its center, with lines drawn across connecting both sides of the arch at these centers.

The second bicuspids, to be sure, are seen to be slightly in front of the deciduous second molars. But, and this observation has not, to our knowledge, hitherto been cited, all the other permanent teeth are clearly

somewhat *back* of the corresponding deciduous teeth, with reference both to centers and to distal surfaces of the teeth.

However, as indicated by Brash, and demonstrated in the present paper, the central incisors are not stable, but manifest appreciable anteroposterior movement, especially during the transition from deciduous to permanent teeth. Consequently, the relationship of the permanent and deciduous teeth as suggested by Colyer in his figure, would perforce require modification.

Franke, as previously mentioned, had noted changes in position of the teeth by relating dentitions on a base line joining both sides of the arch immediately in front of the permanent molars, relying on the assumption that these molars were stable. Superimposition of dentures by this method revealed a backward movement of all the teeth in the transition from deciduous to permanent dentitions; i.e., the ten anterior teeth of the permanent arch were located behind, or inside, the arch formed by the deciduous teeth.

Now, the assumption that the permanent first molars are fixed in position has been shown by Brash and the present writers to be untenable, or only tenable in certain cases and within a limited time. Franke, however, in support of his general thesis, points out the fact that the permanent incisors are formed and do erupt behind their deciduous predecessors. It seems to us, however, that the terms "erupting in front" or "erupting back" may be largely a matter of definition. Their usage has not been free from ambiguity. Does the whole permanent incisor, all surfaces, erupt back of the deciduous? or is it merely the lingual surface which is more or less back?

The permanent incisor is of course larger labio-lingually than the deciduous. Hence the former may erupt so that the labial edge coincides with that of the preceding deciduous incisor and still be considerably back of the deciduous tooth lingually.

It seems to us, therefore, with regard to Franke on eruption of the permanent teeth behind the deciduous, that it is hardly likely, at least not as a frequent occurrence, for the whole permanent incisor, every surface thereof, to erupt back of the corresponding deciduous tooth.

Moreover, it is obviously important to know whether the permanent incisors, if erupted behind the deciduous teeth, *remain* in this same position. Franke seems to imply that they do.

In the present study the data pertaining to the transition from deciduous to permanent teeth are confined to the incisors only. It was shown (tables 6 and 7) that the incisors are most usually, and to the greatest extent, active in anteroposterior changes during the transition

period. Also, the direction of movement at this time was preponderantly backward; i.e., the location of erupted permanent incisors (their centers) was usually back of the corresponding deciduous teeth (their centers). Yet, there was an unmistakable suggestion that a resurgence forward occurred in the permanent teeth during the ensuing year. The numbers manifesting proximal movement a year after eruption of the permanent teeth rose to the extent of exceeding the preceding dominant distal trend.

A much more desirable insight into the situation, however, would obviously be to follow the changes in direction and amount of incisor movement *in the same individual.* Unfortunately, only a comparatively few cases in our present series were amenable to treatment of this kind, since observations over at least a period of three years were necessary on a single individual. These observations, too, would have had to occur at the time immediately preceding loss of the deciduous teeth, and a year after eruption of the permanent teeth. Albeit, the question is an important one, and the number of cases that could be analysed in this fashion were culled from the material.

Movements of the teeth have hitherto referred to the changes in position of their respective centers; e.g., the center of the tooth one year was back of this same center the year following. In the transition from deciduous to permanent teeth, however, there is of course a change in tooth dimensions. A consequence of this difference in the incisors has already been intimated. To further illustrate the implications of this change in tooth size of the incisors, the permanent centrals are on the average 2.0 mm. larger labio-lingually[10] at the neck than their deciduous predecessors. Hence, should the center of the permanent tooth fall directly over the center of the deciduous incisor, the labial surface of the permanent would still extend 1.0 mm. beyond the labial surface of the deciduous tooth. Likewise, the lingual surface of the permanent tooth, under these circumstances, would extend farther back 1.0 mm. than the lingual surface of the deciduous.

In view of this difference between the sizes of deciduous and permanent incisors, it was felt the picture might be clarified should the *labial surface,* instead of the centers, be taken as landmarks from which to note changes in position between the two types of teeth. This was done in the following simple manner. If the centers of the permanent

[10]Black, G. V., Descriptive Anatomy of the Human Teeth. 4th ed., 1902, *Philadelphia.*

median incisors fell 0.5 mm. behind the centers of their deciduous predecessors, the labial surface of the former was 0.5 mm. *in front of* the labial surface of the corresponding deciduous teeth. For, if the centers of the two teeth had coincided, and because of the difference in size, the labial edge of the permanent would have been *1.0 mm. in front* of the deciduous teeth. Again, with the centers of the permanent median incisors 2.0 mm. back of the deciduous, its labial surface would be *back* 1.0 mm. in relation to the labial surface of the latter.

The average labio-lingual diameters, taken at the neck of the tooth, of temporary and permanent incisors, were culled from Black, and are given in Table 8.

TABLE 8

Average Labio-lingual Diameters at Necks of Deciduous and Permanent Incisors (from Black's Dental Anatomy)

	UPPER		LOWER	
	Centrals (*mm.*)	Laterals (*mm.*)	Centrals (*mm.*)	Laterals (*mm.*)
Deciduous	5.0	4.8	4.0	4.0
Permanent	7.0	6.0	6.0	6.4

Several cases with space retainers were added to raise the number of observations. The space retainers were in the molar region and it was considered very unlikely that they could have any appreciable influence on the movements in the incisor region.

In Table 9 are given the incidence and average amount of anteroposterior movement (1) between the *centers* of the deciduous and immediately erupted permanent incisors; (2) between the *centers* of the immediately erupted permanent incisors and these same incisors a year after eruption; (3) between the *labial surfaces* of the deciduous and immediately erupted permanent incisors; and (4) the total amount of change (average) between the *labial surfaces* of the deciduous and permanent incisors, a year after eruption of the latter. It will be remembered that in any given category, e.g., upper median incisors in normal occlusion, the observations from deciduous to permanent teeth a year after eruption, were obtained on the *same individual.*

TABLE 9

Position of Permanent Incisors in Relation to Their Deciduous Predecessors

LAND-MARKS	MOVEMENT	NORMAL OCCLUSION					MALOCCLUSION				
		Forward		Backward		None	Forward		Backward		None
		No.	Mean (mm.)	No.	Mean (mm.)	No.	No.	Mean (mm.)	No.	Mean (mm.)	No.
Upper Median Incisors											
Tooth Centers	$D-P^1$	2	0.60	10	0.64	..	7	0.60	10	0.67	2
	P^1-P^2	8	0.52	4	0.37	..	16	0.53	3	0.13	..
Labial Edges	$D-P^1$	9	0.78	2	0.15	1	17	1.02	2	0.50	..
	$D-P^2$	11	0.90	1	0.50	..	18	1.40	1	0.60	..
Lower Median Incisors											
Tooth Centers	$D-P^1$	2	0.55	11	0.83	1	..	...	14	1.05	..
	P^1-P^2	11	0.95	2	0.85	1	13	0.84	1	0.70	..
Labial Edges	$D-P^1$	9	0.88	5	0.42	..	9	0.54	4	0.80	1
	$D-P^2$	13	1.18	1	0.70	..	12	1.04	2	0.25	..
Upper Lateral Incisors											
Tooth Centers	$D-P^1$	1	0.10	3	0.60	..	11	0.49	4	0.30	1
	P^1-P^2	2	0.25	2	0.40	..	5	0.30	7	0.67	4
Labial Edges	$D-P^1$	3	0.46	1	0.70	..	15	0.98	..	...	1
	$D-P^2$	3	0.23	1	0.30	..	13	0.82	1	0.10	2
Lower Lateral Incisors											
Tooth Centers	$D-P^1$	1	0.10	4	1.15	4	5	0.66	18	0.88	..
	P^1-P^2	5	0.28	3	0.36	1	13	0.60	9	0.35	1
Labial Edges	$D-P^1$	8	0.97	1	1.50	..	21	0.84	2	1.35	..
	$D-P^2$	7	1.07	2	0.45	..	21	0.96	2	0.85	..

$D-P^1$—Deciduous to erupted permanent teeth

P^1-P^2—Erupted permanent to permanent a year after eruption

$D-P^2$—Deciduous to permanent a year after eruption

The results are both interesting and instructive. Considering movements according to *centers* of teeth first, it is seen that the predominating tendency, as observed before, is for the permanent incisors to erupt back of their deciduous predecessors; one exception occurs, namely, the upper lateral incisors in malocclusion, which evince a somewhat greater incidence of forward movement. The year following eruption of the permanent incisors, however, the direction of movement is largely reversed, as was indicated in the preceding data. In short, the permanent incisors at eruption do not remain stable, but within a year after eruption have manifested appreciable movement and in the forward direction.

The picture becomes quite changed when the data are analysed according to *labial surfaces* of the respective teeth. Consistently and predominantly the labial surfaces of the erupted permanent incisors are now *in front of* the labial surfaces of the corresponding deciduous teeth.

What may perhaps be of greater significance are the differences in amounts of change in cases with normal occlusion and malocclusion, and between the upper and lower teeth. We note that in normal occlusion the lower incisors move somewhat more extensively forward than do the same teeth of the upper arch. In other words, there is the obvious suggestion that the horizontal overbite or space between the upper and lower teeth, in *normal occlusion,* has diminished in the transition from deciduous to permanent incisors.

In malocclusion the direct converse is discernible. Here the upper teeth have gone forward appreciably more extensively than have the lower teeth, in consequence of which the horizontal overbite, or relative protrusion of the upper arch, is now perceptibly greater than could have been in the deciduous dentition.

Finally there are the total average changes in position between the labial surfaces of the deciduous incisors and those of the permanent teeth a year after eruption. The amounts are seen to be appreciable. The prevailing direction has been the forward. And herein also, with a single exception, namely, the lateral incisors in malocclusion, there is a marked tendency for upper and lower incisors to converge in normal occlusion, and to diverge in malocclusion, likewise the result of differential amounts of forward movements. It may be mentioned that this difference between proper and malocclusion in total movement was also observed when the data, the same as utilized in the above, were tabulated according to centers of teeth.

Another point should be recognized. The eruption of the labial surface of the permanent central incisor, on the average 0.78 mm. in front of the like surface of its deciduous predecessor in normal occlusion (table 9), means that the *lingual* surface of the permanent tooth is *1.22 mm. back of the lingual surface* of the deciduous incisor. Considering the lingual surface, therefore, the permanent teeth still are usually *back* of the deciduous. As already observed, what is meant by erupting in front of or in back of is essentially a matter of definition.

The question may arise whether certain forms of malocclusion would not preclude movements as depicted above. It is well known, for example, that the type of malocclusion where lower incisors protrude horizontally beyond those of the upper, may and often does remain virtually unchanged throughout the life of the individual. Indeed, it would obviously be highly desirable in these cases for the upper incisors to move forward relatively more than the lower.

The practice of including all types of malocclusion in one single classification undeniably tends to obscure the situation. Assuredly, it is not likely, to say the least, that growth changes are occurring in the alveolar arches of an individual with markedly horizontally protruding upper teeth similar to those in an individual with excessively protruding lower teeth. Yet such has hitherto been the usual manner of presentation of data. This situation has probably been due to the fact that the series previously observed were usually very small, besides which the latter-mentioned type of malocclusion is a relatively rare one.

In the present instance, too, there were only a few cases with "undershot" jaws, so few that it was considered impracticable to segregate them for separate observation, especially when dealing with averages. One such case, however, occurs in our small series depicting the changes between deciduous and permanent incisors in the same individual. It is an exceptionally instructive case, and will therefore be described in some detail. The movements, occurring between ages 6 and 9 years, inclusive, were as follows:

(1) Labial surfaces of permanent *upper central* incisors were in *front* 3.3 mm. of labial surfaces of deciduous predecessors (first two years, deciduous teeth present; latter two years, permanent).

(2) Labial surfaces of permanent *lower central* incisors were *back* 1.5 mm. of labial surfaces of deciduous predecessors (first year, deciduous teeth present; latter three years, permanent).

(3) Labial surfaces of permanent *upper lateral* incisors were in *front* 0.7 mm. of the labial surfaces of their deciduous predecessors (three years, deciduous teeth; one year, permanent).

(4) Labial surfaces of permanent *lower lateral* incisors were 0.6 mm. *back* of the labial surfaces of their deciduous predecessors (first year, deciduous; second year deciduous lost but permanent not yet erupted; latter two years, permanent).

Now, these figures could only mean that the malocclusion was becoming radically changed, and for the better. In figure 6 are given photographs of the child's dentition taken at 6 years 5 months and 9 years 5 months, respectively. A remarkable improvement in occlusion is clearly discernible, and precisely in the manner suggested by the tabular data. It is to be remembered that the child had received no orthodontic treatment whatever.

This correspondence between data and actually perceived occlusal relationships seems to us additional support for the general methodology.

The maximum movements or changes in position between the respective labial surfaces of deciduous and permanent teeth, the latter a year after eruption, are given in table 10. Each maximum represents the total change in a single individual.

TABLE 10

Maximum Single Movements Between the Labial Surfaces of Deciduous and Permanent Incisors One Year after Eruption

OCCLUSION	UPPER				LOWER			
	Centrals		Laterals		Centrals		Laterals	
	F.	B.	F.	B.	F.	B.	F.	B.
	millimeters							
Normal	2.3	0.5	0.5	0.3	2.3	0.7	1.5	0.7
Abnormal	2.7	0.6	1.3	0.1	2.0	0.3	1.9	1.0

It is to be understood, of course, that proximodistal changes in position of the teeth are undoubtedly accompanied by changes in the widths of the arches, and may, indeed, merely be the result of such lateral growth.

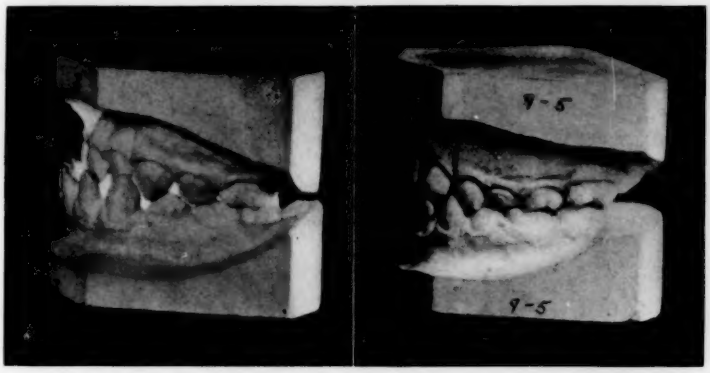


FIG. 6. DENTAL CASTS OF CASE 88, GIRL, INDICATING CHANGES IN THE ALVEOLAR REGIONS AND OCCLUSION; THERE WAS NO ORTHODONTIC TREATMENT A—6 YRS. 5 MOS., B—9 YRS. 5 MOS.

UNIV. OF MICH.

In conclusion we would like to make clear that the proposed method of determining anteroposterior movements of the teeth, and the results it disclosed in the material at our disposal, are given merely as another possible way of clarifying an admittedly difficult problem. Both methodology and conclusions assuredly require careful and critical verification. It is hoped that our presentation, if it shall have done nothing else, will have stimulated such studies, which cannot but contribute to the elucidation of this important problem.

SUMMARY

A new method is suggested for determining anteroposterior movements of the teeth in the alveolar arches proper. This method consists simply of projecting orthographically, at the gingival margins, the dentitions from plaster casts. Next are located the centers of the respective tooth areas, easily ascertained with the aid of a compass. With these centers representing the teeth in the denture as foci, the geometrical center and axis of least asymmetry of the dental arches are plotted.

The dental casts taken at various ages on the same individual are related by means of this arch center and axis. Changes in position between the centers of corresponding teeth in these superimpositions indicate the direction and extent of movements. An experimental attempt to verify the method is described.

Observations were obtained on the dentitions of 183 children between the ages of 2 to 10 years. Casts were taken at yearly intervals, over a span of 2 to 6 years. The data were treated according to age, movements of the individual teeth in upper and lower arches, deciduous and permanent teeth, and normal and abnormal occlusion.

The results of the study were:

1. Movements of the deciduous teeth are not confined to one direction: both anterior and posterior shifts occurred.

2. A generally greater tendency toward backward movement was apparent in the early years (about 2 to 7 years), after which the trend became forward. The first permanent molars, especially of the lower arch, manifested a greater tendency toward anterior shifts throughout.

3. Among all the teeth a substantial percentage of cases manifested practically no movement within a single age interval. It is, however, considered hardly likely that any tooth remains absolutely stable over a span of several years, especially during the period of alveolar and facial growth.

4. The teeth in malocclusion generally appear more susceptible, and in larger average amounts, to anteroposterior movements than do the teeth in normal occlusion.

5. The greatest amount of movement or changes in position of the teeth occurred in the incisors during the transition from deciduous to permanent teeth.

6. The labial edges of the permanent incisors were found to erupt appreciably in front of the labial surfaces of their deciduous predecessors. However, because of the greater labio-lingual size of the former, their lingual surfaces also extended considerably beyond those of the deciduous teeth.

7. In the transition between deciduous and permanent incisors in normal occlusion the labial surfaces of the lower incisors were forward somewhat more extensively than the upper teeth, implying thereby a diminution of horizontal overbite at this time. Conversely, in malocclusion the labial surfaces of the upper incisors had shifted forward an appreciably greater extent than the lower, a consequence of which must be an increased horizontal protrusion of the upper teeth in relation to the lower.

LITERATURE CITED

BLACK, G. V. (1902): Descriptive Anatomy of the Human Teeth. 4th. ed., *Philadelphia.*

BRASH, J. C. (1924): The growth of the jaws and palate. Lectures on the growth of the jaws, normal and abnormal, in health and disease. *Dent. Board of the U. K., London,* p. 23.

———. (1924): The genesis and growth of deformed jaws and palates. *Ibid.,* p. 67.

———. (1928): The growth of the alveolar bone and its relation to the movements of the teeth, including eruption. *Intern. J. Orth.,* v. 14, pp. 196-223, 283-293, 398-405, 487-494.

———. (1929): The etiology of irregularity and malocclusion of the teeth. *Dent. Board of the U. K., London.*

COLYER, J. F. (1920): A note on the changes in the dental arch during childhood. *Dent. Record,* v. 40, p. 273.

FISH, G. D. (1917): Technology in orthodontia. *Intern. J. Orth.,* v. 3, no. 6

———. (1917): Some engineering principles of possible interest to orthodontists. *Dent. Cosmos,* September.

FRANKE, G. (1921): Über Wachstum und Verbildung des Kiefers und der Nasenscheidewand, auf Grund vergleichender Kiefermessungen und experimenteller Untersuchungen über Knochenwachstum. *Leipzig.*

GOLDSTEIN, M. S., and F. L. STANTON (1935): Changes in dimensions and form of the alveolar arches with age. *Intern. J. Orth.*, v. 21, no. 4, p. 357.

HELLMAN, M. (1933): Growth of the face and occlusion of the teeth in relation to orthodontic treatment. *Intern. J. Orth.*, v. 19, no. 11, p. 1116.

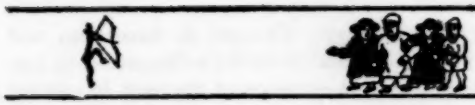
LEWIS, S. J., and I. A. LEHMAN (1929): Observations on growth changes of the teeth and dental arches. *Dent. Cosmos*, v. 71, p. 480.

STANTON, F. L. (1922): Arch predetermination and a method of relating the predetermined arch to the malocclusion, to show the minimum tooth movement. *Intern. J. Orth.*, v. 8, no. 12, p. 757.

STANTON, F. L., G. D. FISH and M. F. ASHLEY-MONTAGU (1931): Description of three instruments for use in orthodontic and cephalometric investigations, with some remarks on map construction. *J. Dent. Res.*, v. 11, no. 6, p. 885.

STANTON, F. L., and R. H. HANAU (1915): An instrument for surveying and mapping the denture. *Proc. Panama-Pacific Dental Congress.*

SMYTH, C., and M. YOUNG (1932): Facial growth in children, with special reference to dentition. *Med. Research Council, London.*



PHYSICAL DEVELOPMENT IN RELATION TO MENARCHEAL AGE IN UNIVERSITY WOMEN[1]

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IN CONNECTION with a study (14) of the relation of age at the menarche to intelligence and personality traits in college and university women, the authors demonstrated the presence of low but significant correlations between menarcheal age and height, weight, and ht./wt. ratio. These relationships and also those between chronological age and physical growth have been studied further in university women of the ages 17 to 21 and the results will be presented in the following paper.

Our data consist of measurements of height, weight, bi-iliac diameter, and chest-width at the level of the nipple. Height and weight measurements were obtained for 1290 individuals. Of this number, remeasurements of height and weight were completed on 1134 of these same individuals after the lapse of one year, and on 446 after the lapse of two years. Table 1 gives the number of individuals measured and remeasured at each chronological age from 17 to 21, inclusive. No chest and hip remeasurements were made.

Most of the data except width measurements were taken from the students' health cards on file in the Department of Physical Education for Women, where the height and weight of each freshman and sophomore student along with other data of importance to the department are recorded at the beginning of the school year, or at the time

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The authors gratefully acknowledge their indebtedness to Dr. Dorothy H. Heilman, Director of Physical Education for Women, Stanford University, for permission to assemble data from the department of physical education. All of the data pertain to women students enrolled between the years 1924 and 1934. Code numbers were substituted for names by a member of the physical education staff in order to conceal the identities of all individuals to whom these data pertain.

TABLE 1

Number of Subjects at each Chronological Age for whom Measurements of Height, Weight and Width (Bi-iliac, Chest) and Remeasurements of Height and Weight were Obtained

	HEIGHT AND WEIGHT				WIDTH
CHRONOLOGICAL AGE	NUMBER FIRST MEASURED AT AGE SPECIFIED	TOTAL NUMBER MEASURED AT AGE SPECIFIED	REMEASUREMENTS AFTER 1 YEAR INTERVAL	REMEASUREMENTS AFTER 2 YEAR INTERVAL	NUMBER MEASURED
17	331	331	...	...	52
18	553	783*	224	...	193
19	263	718*	435	132	182
20	94	474	339	214	153
21	49	210	136	100	88
TOTAL	1290	2516	1134	446	668

* 784, in the case of weight
* 717, in the case of weight

of matriculation, if that occurs at some other time. For the most part, the data on the junior and senior classes were obtained in the autumn quarter of 1934 when, at our request, physical measurements were made on all undergraduate women. For approximately 16 per cent of the cases, one or more records of height and weight were obtained from colleges or universities attended prior to entering Stanford. These were used only when height and weight measurements for the same individual were on file at Stanford University. The chest and hip measurements were made by a trained assistant in the autumn quarter of 1934. The age at the time of the first menses (menarcheal age) was obtained by the Department of Physical Edu-

cation as one item of a comprehensive health questionnaire filled out by the student at or near the time of matriculation.

ACCURACY OF THE DATA

Owing to the fact that the height and weight measures were made over a series of years, by different technicians, and sometimes with different instruments, the reliability of our data may be considerably below that which would have obtained if a single technician, using the same instruments, had made all of the measurements. We have no evidence, however, that a systematic bias relative to any of the variables of this investigation has operated. Probably, therefore, the unreliability of our data operates only to make the obtained variability exceed the true variability. To the extent that this is true, the obtained correlations will be correspondingly lower than the true correlations, and the obtained differences will be correspondingly less significant than the true differences.

The accuracy of the menarcheal ages as reported by young adults, who for the most part have kept no calendar records, is a matter for conjecture as has been suggested by previous authors (4). We have, however, a bit of evidence on the consistency of testimony with respect to menarcheal age. When requesting height-weight data from institutions previously attended by our subjects, we also asked for the age at the menarche, if it had been recorded on the student's card. This datum was given for 116 cases. Subsequently these students gave information on this point when completing the health questionnaire at Stanford. Thus we obtained two reports on menarcheal age with intervals ranging from one to six years. Of the 116 cases, a discrepancy of 2 years was found in four instances, and a discrepancy of 1 year in 36 instances. No doubt some of the one-year discrepancies are not genuine errors of testimony but are to be ascribed to the fact that certain students took their last birthday as a basis of reckoning at one time and their nearest birthday at another. The correlation found between menarcheal ages reported on the two occasions is .84. This indicates that there is a very considerable degree of consistency of report as to menarcheal age. Obviously this evidence is in the right direction but, regrettably, it does not tell us whether the reported ages are correct.

PROCEDURE FOR DISTRIBUTING MEASUREMENTS WITH RESPECT TO AGE-CATEGORIES

The ages at which measurements or remeasurements were made varied widely with respect to the subjects' birthdays, hence it was necessary to adopt an arbitrary policy for the assignment of each measurement to a special age interval. We assigned to a given age-group any measurement that was made within an interval of 6 months preceding and 6 months following the birth date. For example, the age 17 included all cases measured between 16 years and 7 months and 17 years and 6 months, the year 17 being the mid-point of this age range.

Although the majority of remeasurements followed previous measurements by an interval of 1 or 2 years there were some instances in which one or both of the successive measurements only roughly approximated these intervals. When the interval fell short of 8 months we used only one of the measurements, namely, the one that was nearest the subject's birthday. To be counted as a one year interval the elapsed time could not exceed 16 months. To be counted as a two year interval the elapsed time had to fall between the limits of 20 and 28 months. The means of the one and the two year intervals are, respectively, 11.5 and 23 months.

The available records on menarcheal age do not allow us to determine the actual age intervals used by the women when recording their menarcheal ages. The health questionnaire merely asks for the age when first menstruation began, and an integer denoting the year of age was given in answer. There was no way of distinguishing those subjects who gave the menarcheal age as that of the birthday preceding from those who gave it as that of the birthday nearest to the onset of the menses.

ANNUAL AND BIENNIAL GROWTH INCREMENTS

Only rarely have consecutive measurements of college or university women been reported in the literature of this subject. For the most part, studies of the relations between chronological age and physique have dealt with independent samplings of the college population at each age. When our data are analysed in this way we obtain the results presented in tables 2 (upper part) and 3, to which each subject contributes but one set of measurements. When two or more annual measurements were available for a given subject, we used only the

first of these in the present calculations. With but few exceptions the subjects distributed in the 17 and 18 year brackets were Freshmen. A large number of the 19, 20, and 21 year old women were first measured at Stanford in their sophomore, junior, or senior years, having previously attended some other institution.

TABLE 2

Height and Weight Data for Women Students at Stanford University

AGE	N	HEIGHT (inches)			WEIGHT (pounds)		
		Mean	S. D.$_m$	S. D.$_{dist.}$	Mean	S. D.$_m$	S. D.$_{dist.}$
(Independent samples at each age; no remeasurements)							
17	331	64.75	.09	1.69	124.85	.85	15.72
18	553	64.71	.09	2.19	123.05	.65	15.31
19	263	64.72	.14	2.26	123.24	.98	15.84
20	94	64.63	.23	2.28	120.90	1.41	13.70
21	49	64.54	.34	2.37	125.56	2.80	19.58
(All available measurements at each age; successive samples included)							
17	331	64.75	.09	1.69	124.85	.86	15.72
18	783	64.72	.08	2.19	124.03	.55	15.52
19	718	64.80	.08	2.26	125.10	.60	16.02
20	474	64.82	1.05	2.28	123.89	.70	15.17
21	210	64.61	1.63	2.38	122.93	1.07	15.47

The statistical constants for the non-successive height and weight data are given in the upper part of table 2. It will be noted that there is no consistent change in mean height from age to age, and that all differences are small in amount. None of the differences are of statistical significance. The mean weights, likewise, show no consistent relation to chronological age. At the age of 20 years the mean weight is somewhat lower than one would have expected from the trend of the preceding and following means. We have no way of determining whether this drop in weight at 20 years is to be ascribed to selective factors that have operated in determining the constituents of our populations or whether it is merely a chance fluctuation that approaches statistical significance.

TABLE 3

Chest Widths and Bi-iliac Diameters of the Women Students at Stanford University.

Independent Samples at Each Age

AGE	N	CHEST WIDTH (centimeters)			BI-ILIAC DIAMETER (centimeters)		
		Mean	$S.D._m$	$S.D._{dist.}$	Mean	$S.D._m$	$S.D._{dist.}$
17	52	25.94	.19	1.35	27.90	.17	1.24
18	193	25.38	.10	1.41	27.95	.11	1.55
19	182	25.27	.10	1.36	27.88	.11	1.46
20	153	25.63	.11	1.42	28.04	.13	1.59
21	88	25.53	.13	1.27	27.81	.17	1.55

Referring to table 3, it may be seen that there is no significant or consistent relationship between mean bi-iliac diameter and chronological age. Also, with respect to mean chest width there is no consistent relationship running through the age ranges, although the difference at 17 and 19 years is 3.12 times its standard error. No satisfactory explanation of the latter difference has been found.

The foregoing results on height and weight conform in a general way with results from independent samplings reported by other investigators (1, 3, 6, 7, 8). They give no evidence that college women of the ages of 17 and 18 have not completed their growth, as certain investigators have concluded (1, 3), but as we shall show, these are not the kinds of data from which a positive conclusion to this effect can be drawn.

The statistical constants for consecutive measurements will be found in tables 4 and 5. Here the mean heights and weights at the time of the original measurement and at the time of the remeasurement after the lapse of one and of two years are given for each group. The one and two year increments and the measures of variability and significance are included.

In the case of height it will be noted that there is a small, significant, mean annual increment for consecutive ages from 17 to 20 years.

TABLE 4

Mean Increments in Height, Based Upon Consecutive Measurements of the Same Individuals

MEASURED AT	*N*	HEIGHT AT YOUNGER AGE		HEIGHT AT OLDER AGE		*r**	INCREMENT	INCRE. / S.D.$_{incre.}$
		Mean	S.D.	Mean	S.D.			
17 & 18	224	64.603	1.418	64.763	2.175	.979	.160	2.8
18 & 19	435	64.698	2.125	64.853	2.203	.968	.155	5.9
19 & 20	339	64.807	2.288	64.898	2.311	.982	.091	3.8
20 & 21	136	64.426	2.338	64.441	2.294	.984	.015	0.4
17 & 19	132	64.462	1.612	64.750	2.184	.965	.288	4.4
18 & 20	214	64.621	2.135	64.790	2.191	.953	.169	3.7
19 & 21	100	64.620	2.261	64.740	2.410	.972	.120	2.1

* Product-moment correlations between the measures at the younger and at the older ages.

The increment for the period of 20 to 21 years is not statistically significant. The biennial increments for the 17 to 20 year period are greater in absolute amount and also are clearly significant. As is inferred[3] from these data the total average increment for the four year period, 17 to 21, amounts to approximately .4 inches.

Significant mean annual increments in weight are also indicated by the consecutive measures between the ages of 17 and 19 years; significant biennial increments occur between the ages of 17 and 20 years. For the four year period, 17—21, the estimated[3] total increment in weight is 5.75 pounds.

The foregoing data which show a continuous, annual increase in the mean height and weight of Stanford women are corroborated by three similar studies that have come to our attention. Baldwin (2) reported four consecutive, annual mean heights and weights for 80 Swarthmore girls. His data are given in

[3] The legitimacy of inferring the average four-year increment from the separate annual increments is based upon the assumption that while there has been selection in respect to the heights of the individuals measured at the different age-pairs, there has been little or no selection with respect to average, annual growth increments.

TABLE 5

Mean increments in Weight, Based Upon Consecutive Measurements of the Same Individuals

MEASURED AT	N	WEIGHT AT YOUNGER AGE		WEIGHT AT OLDER AGE		r*	INCREMENT	INCRE. / S.D.incre.
		Mean	S.D.	Mean	S.D.			
17 & 18	224	124.175	15.671	126.605	15.823	.919	2.430	5.8
18 & 19	436	124.060	15.892	126.065	16.031	.923	2.005	6.6
19 & 20	339	124.300	15.798	124.800	15.802	.929	0.500	1.5
20 & 21	135	121.020	13.001	121.835	13.979	.915	0.815	1.7
17 & 19	132	123.370	16.173	126.170	16.868	.893	2.800	4.2
18 & 20	210	121.855	15.359	124.355	15.522	.910	2.500	5.5
19 & 21	100	121.700	13.282	122.800	14.283	.913	1.100	1.9

* Product-moment correlations between the measures at the younger and at the older ages.

table 6. Apparently age was not taken into account in combining the data. Since no measures of variability are given at the different college years, we are unable to determine whether these apparent increments from class to class are statistically significant. The mean increment in height from the freshman to the senior year is .49 inches, and the mean increment in weight for the same period is 4.66 pounds. On the whole, the findings conform to those reported by us in the present paper.

TABLE 6

Increments in Height and Weight

(Previous Publications)

BALDWIN (2) SWARTHMORE COLLEGE N 80			GOULD (7) NEWCOMB COLLEGE N 875 (ht), 866 (wt)			YOUNG (16) PHYSICAL CULTURE COLLEGE N 50	
Class	Height	Weight	Mean Age	Height	Weight	Age	Height
Fr.	62.82	116.75	17.5	63.33	115.49	18.0-18.9	64.31
So.	63.01	120.50	18.5	63.50	116.99	19.0-19.9	64.49
Jr.	63.12	120.99	19.5	63.60	117.46	20.0-20.9	64.61
Sr.	63.31	121.41	20.5	63.63	117.66	.....	....

Data recently reported by Gould (7) on 875 Newcomb College women include height and weight measurements of all women who were in residence for four consecutive years between 1909 and 1929. The chronological ages are not dealt with separately, so that at each of the designated college years considerable variation in age occurs. These data are given in table 6. In testing the significance of the mean increment from the freshman to the senior years two estimates have to be made in lieu of the exact data required. The standard deviations of the distributions of the measures for the freshman and senior years are not given; however, the standard deviations of the distributions of 1247 freshman heights and weights of Newcomb College women are given and but little error will result if these values be used. Also the correlation between measurements at the freshman and senior years is lacking. There is a basis for estimating this correlation in our data reported in tables 4 and 5 above. We found a correlation of approximately .95 between the heights of Stanford women taken two years apart and a correlation of approximately .90 for weights. It would appear that an allowance of ten points for decrement in the correlation for the two added years should be a generous allowance. Using the estimated values for the S. D.'s and the correlation, we may say that the mean height increment of .30 inches between the freshman and senior years is 7.1 times its standard error. In the case of weight, the increment of 2.17 pounds is 6.8 times its standard error. If we are yet more conservative and assume correlations between freshman and senior measures of only .75 and .70 in the case of height and weight, respectively, the critical ratios amount to 4.8 for height and 5.5 for weight. Hence it is apparent that there was a significant mean increment in both height and weight between the freshman and senior years at Newcomb College.

A third study bearing upon the present inquiry is that of Young (16) who reported three annual measurements of height on 50 girls attending the College of Physical Training (London). His data are given in table 6. Young found an increment of .30 of an inch between the years 18.5 and 20.5, but concluded that the difference was not significant. Apparently he did not include the correlational factor (9, p. 182) in testing for the significance of the difference. Assuming that there is as high a correlation between successive measurements as was found in our own data, (see tables 4 and 5) we are justified in correcting for this omission. Assuming the value of the correlation between height at 18.5 and 20.5 years to be .95, we find that the increment in height in this two-year period is 4.8 times its standard error. Thus it appears that, when correctly analysed, Young's data support the hypothesis that there is a mean increment in height and weight of college women of the ages herein considered.

The growth curves derived from these studies and those inferred from our own are shown in figure 1. In the case of height it is readily seen that the forms of the curves from our data and from Young's and Gould's are very similar. The curve from Baldwin's data lacks the characteristic negative acceleration of the others. The slopes of the curves, indicating the rate of growth at each age, appear to be very similar in all cases.

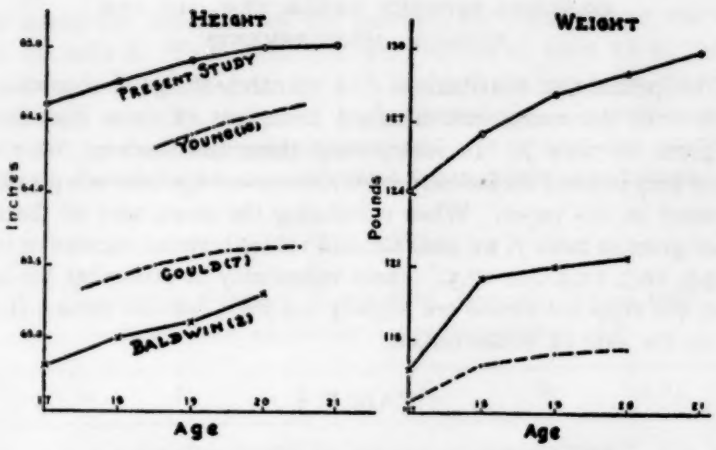

FIG. 1. GROWTH CURVES FOR MEAN HEIGHT AND WEIGHT OF COLLEGE WOMEN (Baldwin's data pertain to Freshman, Sophomore, Junior, and Senior classes. Ages were not given. We have arbitrarily assigned the ages 17-20 to these class groups.)

The forms of the curves showing mean growth in weight are similar for all the studies, but the rate of growth inferred from our data is somewhat greater than that indicated by the others.

On the basis of the accumulated evidence it appears certain that, on the average, growth in height and weight continues at a decreasing rate throughout the college years. The age at which mean growth ceases altogether cannot be stated, but it appears to be at an age beyond 20 years. The reason that studies based upon independent samples of the female college population at different ages fail to reveal this growth is undoubtedly the differential selection with respect to the physique of college women of different ages. This was suggested by Jackson in 1928 when by this method he failed to find evidence of growth on college women. He said, "The most probable explanation is that younger college entrants represent a group precocious physically as well as mentally" (8, p. 390). Although the correlation between mental and physical precocity is known to be low (12), the young college entrants are selected not only for mental achievement, but also for economic advantages and good health, both of which undoubtedly are positively correlated with physique.

RELATIONS BETWEEN MENARCHEAL AGE AND PHYSICAL MEASUREMENTS

The percentage distributions of menarcheal age frequencies together with the means and standard deviations of these distributions are given in table 7. In interpreting these distributions the reader should keep in mind the indeterminate menarcheal age intervals previously discussed in this paper. When calculating the mean ages of the menarches given in table 7, we used the mid-values between successive years, e.g. 9.5, 10.5, 11.5.... 17.5. These values may be somewhat too large. If so, the reported means are slightly too high, but the errors, if any, are on the side of conservatism.

TABLE 7

Menarcheal Age of Students at Stanford University. Independent Samplings at Each Age

C. A.	*N*	PERCENTAGE DISTRIBUTION MENARCHEAL AGES									MEAN	S. D.
		9	10	11	12	13	14	15	16	17		
17	331	0.3	1.2	15.4	30.8	32.3	14.5	4.8	0.6	0.0	13.09	1.14
18	553	0.2	0.7	12.8	26.9	33.6	17.5	5.8	2.2	0.4	13.31	1.22
19	263	0.0	0.4	9.1	29.7	30.4	21.3	6.8	2.3	0.4	13.44	1.20
20	94	0.0	1.1	5.3	25.5	33.0	25.5	2.1	3.2	3.2	13.59	1.34
21	49	0.0	0.0	10.2	30.6	32.6	18.4	6.1	2.0	0.0	13.36	1.11

For the present data there appears to be a small but significant increase in mean menarcheal age that is associated with increasing chronological age between the years 17 and 20. The correlation between menarcheal age and chronological age for the entire age range (17—21) is .105 ±.019. This coefficient is similar in sign, in magnitude, and in significance to others heretofore reported (14, 15) for college and university women.

Relations Between Menarcheal Age and Height

The best estimates afforded by our data of the relationships between menarcheal age and height at the chronological ages involved in

this study are indicated by the correlational constants of the lower half of table 8. These constants were computed from all of the data available at each age. At ages 18, 19, and 20 years the correlation coefficients are .127, .138, and .169, respectively. In each case they are over 3.5 times their standard errors. At ages 17 and 21 the coefficients are of similar sign, but are of less certain significance.

TABLE 8

Correlation Between Menarcheal Age and Height and Regression of Height Upon Menarcheal Age

C. A.	N	r	S. D.$_r$	b	S. D.$_b$
Independent samples at each age; no remeasurements[a]					
17	331	.057	.055	.084	.081
18	553	.162	.041	.293	.076
19	263	.119	.061	.222	.114
20	94	.184	.099	.320	.177
21	49	.273	.132	.622	.312
All available measurements at each age; successive samples included[b]					
17	331	.057	.055	.084	.081
18	783	.127	.035	.233	.065
19	718	.138	.037	.258	.068
20	474	.169	.045	.305	.082
21	210	.157	.067	.297	.129

Inasmuch as many of the subjects were measured at more than one age, each constant does not represent a completely independent estimate of the relation between menarcheal age and height. Therefore the fact that the different age groups confirm each other in indicating a low positive relationship should not be given undue weight. None the less, for each particular age they do represent the best available estimate of the true relationship.

[a] Constants of the height and weight distributions will be found in the upper part of table 2; constants for the menarcheal age distributions will be found in table 7.

[b] Constants of the height and weight distributions will be found in the lower part of table 2; approximated constants for the menarcheal age distributions will be found in table 7.

When the chronological age variate is eliminated by the partial correlation technique[5], we obtain a correlation of .138 (standard error: .027) and a regression coefficient of .241 (standard error: .048) for menarcheal age and height.

In the upper half of table 8, correlation and regression coefficients involving completely independent samples of Stanford women at each age are shown. These data are in complete accord with those mentioned above, although their significance is less certain. A single statistic combining these five separate estimates is given in the footnote[5] below.

In view of these data we must conclude that there are low but significant, positive relationships between the reported menarcheal ages and the heights of Stanford women for the chronological ages involved. The importance of these relationships is, perhaps, most clearly indicated by the regression coefficients of table 8, and the regression lines in figure 2. For illustration we will use the partial regression coefficient as the statistic that best summarizes the relationship throughout the age range. This coefficient indicates that for each year's difference in menarcheal age there is an average difference in height of .24 inches. The partial standard error of the mean of an array (age held constant) is .08 inches for arrays differing from the mean by one year (9, p. 177). Therefore, the average difference in the mean heights of women maturing at 12 and at 14 years amounts to .48 inches and its standard error is .11 inches. Between women who mature at 11 and at 15 there is an average difference of nearly an inch in height, an amount that is over eight times its standard error.

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[5]The zero-order coefficients involved in the calculation of the partial correlation are as follows: $r_{ca\ ma}=.105$, $r_{ca\ ht}=-.022$, $r_{ma\ ht}=.135$. Linearity, as determined by Fisher's (5) method, is present for all variates. The chronological age variate, involving as it does only five class intervals, may invalidate to some extent the use of the product-moment correlation in this case. Because of this situation, a further single estimate of the correlation was obtained by a method proposed by Fisher (5). By this procedure the correlations at the separate ages are combined and weighted according to their variance. The only condition is that the data from which the separate coefficients are calculated be drawn from equally correlated populations. Inasmuch as this assumption is implicit in the partial correlation technique, the present method would appear to be as valid as the former method. Futhermore, evidence is presented below which indicates that there are no significant age differences in the correlations between menarcheal age and height. The correlations to be combined will be found in the upper half of table 8. The correlation coefficient obtained by this method is .131 and it is 4.73 times its standard error.

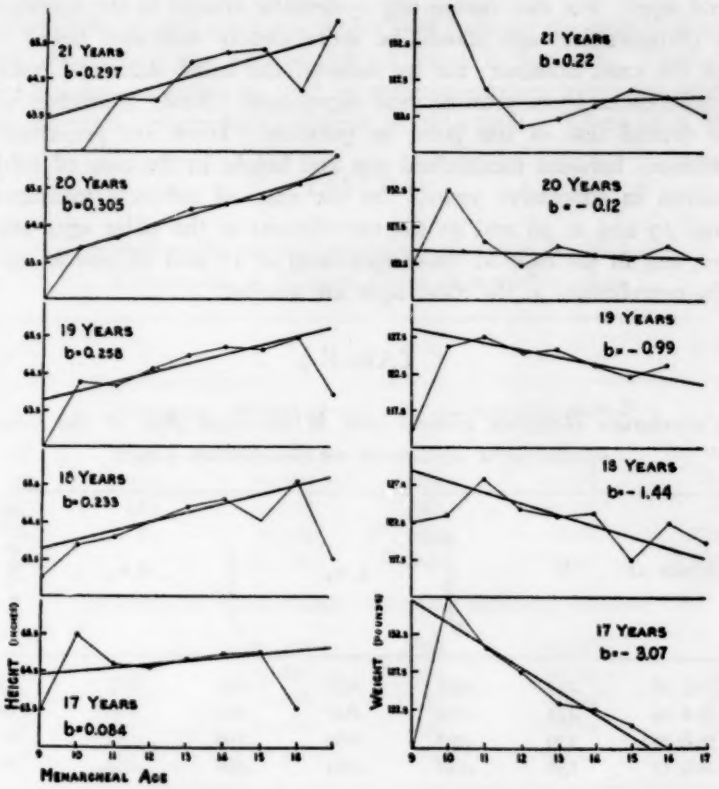

Fig. 2. Regressions of Height on Menarcheal Age (Left) and Weight on Menarcheal age (Right)

The relation between reported menarcheal age and growth may be studied in tables 8 and 9. If the amount of growth between 17 and 21 is related to menarcheal age in a systematic way, a systematic change in the height-menarcheal age correlation would be expected during these ages. Although the correlations of table 8, which involve separate samples of Stanford University women at each age, (upper half of table), show a slight tendency for the correlations at the earlier ages to be lower than those at the older ages, there is in no case a significant difference between a correlation at an early and one at a late age. The coefficients of the lower half of table 8 are based on all of the available data at each age; thus many subjects are represented at

several ages. For this reason any systematic change in the correlations with chronological age should be more clearly indicated here. This is not the case, however, for by none of the usual statistical tests are the differences from year to year significant. Table 9 affords a still more crucial test of the point in question. Here are presented the correlations between menarcheal age and height in the case of subjects measured in successive years. In the case of subjects measured at 18 and 19 and at 20 and 21 the correlations at the older ages are the larger, but in the case of those measured at 17 and 18 and at 19 and 20 the correlations at the older ages are smaller.

TABLE 9

Correlation Between Height and Menarcheal Age in the Case of Subjects Measured on Successive Years[6]

MEASURED AT:	*N*	$r_{\text{younger age}}$	S. D.$_r$	$r_{\text{older age}}$	S. D.$_r$	DIFF./S. D.$'_{\text{diff}}$
17 & 18	224	.055	.067	.037	.067	.85
18 & 19	435	.170	.047	.194	.046	1.60
19 & 20	339	.203	.052	.190	.052	.81
20 & 21	136	.148	.084	.168	.083	.76

In conclusion, one may say that our data give no indication that the amount of annual growth in height between the ages 17 and 21 is related to the reported menarcheal age. Before generalizing on this point, however, one should have more knowledge than is in our possession as to possible selective factors that may have masked low correlations.

[6]Constants of the height and weight distributions will be found in tables 4 and 5, respectively; approximated constants of the menarcheal age distributions will be found in table 7.

[7]The standard error of the difference involves a correlational factor which was computed from formula 129, Kelly (9). The component correlations will be found in tables 4 and 5.

Menarcheal Age and Weight

The correlational constants which best indicate the relationships between menarcheal age and weight are given in table 10. First measurements (upper half) as well as remeasurements after one and two year intervals (lower half) appear in this table. There is a strong

TABLE 10

Correlation Between Menarcheal Age and Weight and Regression of Weight Upon Menarcheal Age

C. A.	*N*	*r*	S. D.$_r$	*b*	S. D.$_b$
	Independent samples at each age; no remeasurements[a]				
17	331	—.223	.052	—3.07	.73
18	553	—.100	.043	—1.25	.53
19	263	—.118	.061	—1.55	.80
20	94	—.099	.102	—1.01	1.04
21	49	+.129	.140	+2.21	2.40
	All available measurements; successive measures included[b]				
17	331	—.223	.052	—3.07	.73
18	784	—.111	.035	—1.44	.46
19	717	—.076	.037	—0.99	.48
20	474	—.010	.046	—0.12	.55
21	210	+.018	.069	+0.22	.90

suggestion of a decreasing negative correlation with increasing chronological age. The trend is consistent throughout the table. The significance of this change is indicated by the differences between the correlations at 17 and at 21 years of age. For the independent samples this difference is 2.4 times its standard error; for all of the available measures the difference is 2.8 times its standard error.

In table 11, the correlations for subjects on whom annual successive measures were available are contrasted. These coefficients confirm the suggestion of a progressive change in the relationship between weight and menarcheal age between the ages of 17 and 21. This change in the weight-menarcheal age relationship is strikingly illustrated by the regression lines of figure 2. The nature of the change, briefly

stated, is as follows: at the age of 17, the early maturing girls are heavier, on the average, than the late maturing girls; but in the following years the difference diminishes progressively until at 20 and 21 years of age it has disappeared entirely. As might be expected, there is a small positive correlation between menarcheal age and the weight

TABLE 11

Correlation Between Weight and Menarcheal Age for Subjects Measured on Successive Years[4]

MEASURED AT:	N	$r_{\text{younger age}}$	S. D.$_r$	$r_{\text{older age}}$	S. D.$_r$	DIFF./S. D.$_{\text{diff}}$
17 & 18	224	—.191	.064	—.126	.066	2.2
18 & 19	436	—.068	.048	—.025	.048	2.0
19 & 20	339	—.004	.054	+.032	.054	1.2
20 & 21	135	+.001	.086	+.013	.086	0.3

increment, as shown in table 12. All of these coefficients are small, but they are consistent as to sign and those for the years 17-18 and 18-19 clearly approach statistical significance. They support the hypothesis that the late maturing girls continue to increase in weight slightly more rapidly than the early maturing girls. Lack of correlation at the ages 19 to 21 may be due, in the present instance, to the fact that more precise, and possibly repeated, measures would be necessary to reveal true relationships when all of the increments are so small.

Differences in the Height-Menarcheal age and the Weight-Menarcheal age Relations

The differences between the height-menarcheal age and the weight-menarcheal age relationships are clearly indicated by the regression lines of figure 2. In table 13 the correlations are brought together for comparison. In every instance, save possibly for the age of 21, there is a significant difference in the magnitudes of the coefficients. These

differences in relationship, together with the fact that height and weight are themselves positively correlated, make the meaning of the foregoing simple correlations between menarcheal age and the measures of height and weight somewhat ambiguous. Because of this ambiguity we should like to know the relationship between menarcheal age and height and weight in groups of subjects who are homogeneous for the dependent variable (height or weight) that is not involved. These relationships have been estimated by means of partial correlations which are given in table 14. All of the relationships revealed by the previous analyses

TABLE 12

Inferred Correlation Between Menarcheal Age and Increment in Weight[8]

INCREMENT BETWEEN AGES	r	S. D.$_r$
17 & 18	.157	.065
18 & 19	.111	.047
19 & 20	.068	.054
20 & 21	.030	.086

[8]The formula from which these correlations were computed is as follows: $r_{a(x-y)} = \dfrac{r_{ax}\sigma_a\sigma_x - r_{ay}\sigma_a\sigma_y}{\sigma_a\sqrt{\sigma_x^2 + \sigma_y^2 - 2r_{xy}\sigma_x\sigma_y}}$, where a = menarcheal age, x = weight at the older age, and y = weight at the younger age. The component correlations will be found in table 11. We are indebted to Dr. Q. McNemar for calling our attention to this procedure.

are verified by this more refined technique, and the significance of the correlations is enhanced. The correlations between menarcheal age and height, with weight constant, are all positive and range from 2.5 to 6 times their standard errors. They undoubtedly represent true relations and there is no evidence that the relation changes with age. In the case of menarcheal age and weight, with height held constant, we again find a systematic change from a highly significant negative correlation at 17 years to a zero correlation at 21 years.

Menarcheal Age and Bi-iliac Diameter

The correlational constants for menarcheal age and bi-iliac diameter are shown in table 15. These constants are small in relation to their standard errors and vary in magnitude from age to age to such an extent that no conclusions as to the reality of the suggested relationships are justified. When height is held constant by partial correlation methods[9] the significance of the coefficients is enhanced but even then they remain very tenuous. When the effects of variation in chronological age are eliminated, the estimated correlation is —.083 (standard error, .038); and when both chronological age and height are held constant the coefficient becomes —.134 (standard error, .038). All these evidences for a low negative correlation must be considered to be very tentative and in need of further confirmation.

TABLE 13

Differences in the Correlations Between Menarcheal Age and Height and Weight[10]

C. A.	*N*	CORRELATION BETWEEN MENARCHEAL AGE AND		DIFF. HT.-WT.	S. D.diff.	DIFF./S. D.diff
		Height	Weight			
17	331	.057	—.223	.280	.057	4.9
18	783	.127	—.111	.238	.037	6.4
19	717	.138	—.076	.214	.037	5.8
20	474	.169	—.010	.179	.043	4.2
21	210	.157	+.018	.139	.067	2.1

[9]Fisher's method of combining correlations is applicable in these cases because there is no evidence of a significant difference in the correlations at the separate ages. Using this method, the estimated values of the correlations are —.106 for bi-iliac diameter, and —.064 for chest width; these values are 2.17 and 1.79 times their standard errors, respectively.

[10]The standard error of the difference involves a correlational factor which was computed from formula 129, Kelley (9). The component height-weight correlations are .416, .454, .480, .536, .518 for the successive years beginning at 17.

TABLE 14

Correlations Between Menarcheal Age and Height with Weight Constant ($r_{ma\ ht\cdot wt}$) and Between Menarcheal Age and Weight and Height Constant ($r_{ma\ wt\cdot ht}$)[11]

C. A.	N	$r_{ma\ ht\cdot wt}$	S. D.$_r$	$r_{ma\ ht\cdot wt}$	S. D.$_r$
17	331	.169	.053	—.272	.048
18	783	.200	.034	—.190	.034
19	717	.198	.036	—.162	.036
20	474	.206	.044	—.120	.045
21	210	.173	.067	—.075	.069

TABLE 15

Correlational Constants for Menarcheal Age and Bi-iliac Diameter[12]

C. A.	N	r	S. D.$_r$	b	S. D.$_b$	r (ht. const.)	S. D.$_r$
17	52	—.112	.137	—.131	.162	—.161	.135
18	193	—.202	.069	—.274	.096	—.275	.066
19	182	+.048	.074	+.058	.090	+.039	.074
20	153	—.054	.081	—.071	.107	—.114	.080
21	88	—.293	.097	—.355	.124	—.380	.091

Menarcheal Age and Chest Width

The correlational constants for menarcheal age and chest width are given in table 16. As in the case of hip width, there are small, negative correlations, but they are not sufficiently significant to enable one to draw conclusions with certainty. The partial correlation with chronological age held constant is —.064 (standard error, .034); and with chronological age and height held constant it is —.094 (standard error, .038).

[11] The zero-order correlations will be found in tables 8 and 10, and in note 10

[12] Constants of the bi-iliac and chest width distributions will be found in table 3, approximated constants for the menarcheal age distributions will be found in table 7.

TABLE 16

Correlational Constants for Menarcheal Age and Chest Width[18]

C. A.	*N*	*r*	S. D.$_r$	*b*	S. D.$_b$	*r* (ht. const.)	S. D.$_r$
17	52	—.056	.138	—.072	.177	—.086	.138
18	193	—.090	.071	—.112	.089	—.126	.071
19	182	—.139	.073	—.157	.083	—.150	.073
20	153	+.035	.081	+.041	.095	+.003	.081
21	88	—.068	.106	—.068	.106	—.130	.106

Menarcheal Age in Relation to Indices of Build

We have used two ratios that, in a certain sense, may be taken as indices of body build: namely, the height/weight and the bi-iliac diameter/height (id/ht) ratios. Correlations between menarcheal ages and each of these indices have been deduced from data appearing in the foregoing tables.[18] Table 17 gives the correlations between menarcheal age and the ht/wt ratio. At the ages 17 and 18 there are significant positive correlations. Thereafter the coefficients, although positive, are too low to be considered significant. As the correlations appear to change systematically with age, no single value for *r* was to be obtained.

Table 18 gives the correlations between menarcheal age and the id/ht ratio. As was to be expected from what we have already learned from these measurements, negative correlations, for the most part, were obtained. When combined by Fisher's method we obtain a correlation of —.163. This is 4.16 times its standard error and undoubtedly is a significant correlation. There is, therefore, a suggestion that during their terminal phase of physical development late pubescent women tend toward the longitudinal (leptosome) type, and early pubescent women toward the lateral (pyknic) type.

[18] The following formula (10) was used in computing these correlations: $r_a \frac{b}{c} = \frac{r_{ab}V_b - r_{ac}V_c}{\sqrt{V_b{}^2V_c{}^2 - 2r_{bc}V_bV_c}}$, where a = menarcheal age, b = height and c = weight. $V = \frac{\sigma}{M}$; thus it makes no difference in what units b and c are measured. The component data will be found in tables 2 and 8 and in note 10

TABLE 17

Correlation Between the Menarcheal Age and Height/Weight Index[33]

C. A.	*N*	*r*	S. D.$_r$
17	331	.257	.051
18	783	.164	.035
19	719	.132	.037
20	472	.049	.046
21	207	.032	.069

TABLE 18

Correlation Between Menarcheal Age and the Ratio Bi-iliac/Height[34]

C. A.	*N*	*r*	S. D.$_r$
17	52	—.180	.134
18	193	—.292	.066
19	182	+.043	.074
20	153	—.079	.080
21	88	—.400	.090

Relation of the Present to Previously Reported Data

Viteles (15), Mills (11), and Stone and Barker (14) have previously reported data on the relation of menarcheal age to height and weight. These results are summarized in table 19. Scheyer (13) studied the relation between body build and menarcheal age in 300 adult patients in a gynecological clinic. He found that those of stocky build (pyknic) are pubescent, on the average, significantly earlier than those of slender build (leptosome). Gordon (6) made the same observation upon Smith College women. So far as they go, it will be seen, their results confirm those of the present investigation.

[34] The formula given in note 13 was used in computing these constants. Component data will be found in tables 2, 3, and 8. The correlations between height and bi-iliac diameter are .374, .453, .518, .491, .408 for the successive years beginning at 17.

TABLE 19

Summary of Previous Data on the Correlation Between Reported Menarcheal Age and Height ($r_{ma\ ht}$) and Weight ($r_{ma\ wt}$) of College and University Women

INVESTIGATOR	SUBJECTS	AGE	N	$r_{ma\ ht}$	$r_{ma\ wt}$
Viteles (15)	Normal School	not given	236	.09 ±.043	—.14 ±.042
Mills (11)	University	not given	641	.148±.026	.....
Stone & Barker (14) (San José data)	Normal School	16-24	336	.153±.036	—.059±.037

In a forthcoming paper the authors will discuss certain relationships between menarcheal age and physical measures of school children ranging from 9 to 15 years of age. Some of the relationships found in the early phases of adolescence are quite different from those that characterize the college women. Therefore, to follow the changing relationships from an early to a terminal phase of adolescent development is a problem of considerable interest and importance.

CONCLUSIONS

From the data analysed in the present paper the following conclusions and interpretations seem justified:

1. Measurements of independent samples of Stanford University women at each age from 17 to 21, inclusive, reveal no consistent change in mean height, weight, bi-iliac diameter, and chest width that is related to chronological age.

2. Successive measurements of height and weight on the same college women show that there is a small, significant mean annual increment for a part of the period from 17 to 21 years.

(a.) In the case of height there is a small, significant mean annual increment for consecutive ages from 17 to 20 years, amounting to approximately .4 inches for the four-year period.

(b.) In the case of weight the mean annual increment is significant for the ages 17 to 19 and the total increment for the four year period is approximately 5.75 pounds.

(c.) These findings are corroborated by results from three previously published papers. Together they strongly suggest the erroneous nature of conclusions as to growth which have been based upon data from independent samples of the female college population at each age.

3. There is a low, positive correlation between reported menarcheal age and the standing height of Stanford women for the ages 17 to 21. The partial correlation, with age constant, is .138 ±.018. For each year's difference in menarcheal age there is an average difference in height of .24 inches. This means, for example, that women who reach puberty at 15 years are, on the average, almost one inch taller than those who become pubescent at 11 years. This difference is over eight times its standard error.

4. The amount of annual growth in stature between the ages of 17 and 21 is not correlated with menarcheal age in the present data.

5. At the age of 17 there is a small negative correlation (—.223 ±.034) between weight and menarcheal age. This relation decreases progressively with chronological age and by 20 and 21 years is entirely absent.

6. The girls who become pubescent relatively late continue to increase in weight during the college years slightly more rapidly than the early pubescent girls.

7. In the terminal phase of physical development the weight-menarcheal age relationships and the height-menarcheal age relationships are quite different.

8. The correlations between menarcheal age and bi-iliac diameter and chest width are negative but of doubtful significance.

9. Correlational studies of menarcheal age in relation to indices of body build (height/weight and bi-iliac/height) indicate that the women with late menarcheal ages tend toward the longitudinal (leptosome) type, whereas those with early menarcheal ages tend toward the lateral (pyknic) type.

REFERENCES

1. BACH, FRITZ. Körperbaustudien an 641 Münchener Studentinnen. *Zeit. f. Konstit. lehre,* 1931, *16,* 28-62.
2. BALDWIN, B. F. The Physical Growth of Children from Birth to Maturity. *Univ. Iowa Studies: Stud. Child Welfare,* 1921, *1* No. 1. Pp. 411.
3. DIEHL, H. S. The heights and weights of American college women. HUMAN BIOL., 1933, *5,* 600-628.

4. ENGLE, E. T., and SHELESNYAK, M. C. First menstruation and subsequent menstrual cycles of pubertal girls. HUMAN BIOL., 1934, 6, 431-453.
5. FISHER, R. A. Statistical Methods for Research Workers (3d. ed.). *Edinburgh*: Oliver and Boyd, 1930. Pp. xiii + 283.
6. GORDON, F. F. Physical measurements of one thousand Smith College students. *Amer. J. Pub. Health*, 1930, 20, 963-968.
7. GOULD, H. N. The physique of women students at Newcomb College of Tulane University. I. Stature and weight. *Research Quart. of the American Physical Education Ass'n*, 1930, 1, No. 1, 1-18.
8. JACKSON, C. M. Physical measurements of the female students at the University of Minnesota with special reference to body build and vital capacity. *Amer. J. Physical Anthrop.*, 1928, 12, 363-413.
9. KELLEY, T. L. Statistical Method. *New York*: Macmillan, 1923, Pp. xi + 390.
10. LEE, A., LEWENZ, M., and PEARSON, K. On the correlation of the mental and physical characters in man. *Proc. Roy. Soc. London*, 1903, 71, 106-114.
11. MILLS, C. A. Geographic variations in the female sexual functions. *Amer. J. Hygiene*, 1932, 15, 593-600.
12. PATERSON, D. G. Physique and Intellect. *New York*: Century, 1930. Pp. xxvii + 304.
13. SCHEYER, H. E. Körperbaustudien an 300 Wöchnerinnen der Kölner Universitätsfrauenklinik. *Zeit. f. Geburtshülfe*, 1932, 102, 579-592.
14. STONE, C. P., and BARKER, R. G. On the relationships between menarcheal age and certain aspects of personality, intelligence, and physique in college women. *J. Genetic Psychology*, 1934, 45, 121-135.
15. VITELES, M. S. The influences of age of puberty upon the physical and mental status of normal school students. *J. Ed. Psych.*, 1929, 20, 360-368.
16. YOUNG, MATHEW. Age of full stature in the female and epiphysial union. *Amer. J. Phys. Anthrop.*, 1928, 12, 285-291.

DISTRIBUTION OF DEATHS AMONG AMERICAN INDIANS

BY CLARK WISSLER

IN 1931 this journal carried an article by Clements dealing with mortality records for certain Indians in Arizona. In 1935 another article by Krogman gave similar data upon a group of Indians in Oklahoma.[1] In the initial study Clements found a type of curve for age-at-death distribution which he believed peculiar to Indians and distinct from Negroes on one hand and whites upon the other. While engaged in an extended study of certain tribes of Indians the writer acquired a register of births and deaths for a community of Dakota Indians which presented an opportunity to test the Clements hypothesis.

A word concerning the source of the data may be in order. The Indians enrolled under the Pine Ridge Reservation, South Dakota, though of one tribe, live in communities. One such community of about 1,000 souls, mostly full-blooded Dakota Indians, has kept a register of births and deaths since 1908. Dr. Scudder Mekeel discovered this register in 1929 while making a special study of this community. He made a copy of it, which he kindly placed at the disposal of the writer. Mrs. R. D. Sanderson generously volunteered to tabulate the entries. The record gave the exact dates for births and deaths, thus making it possible to compile an accurate age-at-death table. In the original compilation the deaths were shown for each successive year, but here it seems unnecessary to give more than the totals for deaths.

Incidentally, the population of this community has gained steadily; as 720 in 1908 and 936 in 1929. The birth rate has been constant, approximately 42 per thousand and the death rate since 1916 approximately 37 per thousand.

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[1] Clements (F.)—Racial differences in mortality and morbidity. HUMAN BIOL., 3. *Baltimore*, 1931, 397-419.

Krogman (W. M.)—Vital data on the population of the Seminole Indians of Florida and Oklahoma. HUMAN BIOL. 7, *Baltimore*, 1935, 335-349.

TABLE 1

Percentage Age Distribution of Deaths

AGE	MOHAVE AND CHEMEHUEVI			DAKOTA			SEMINOLE		
	1910-1930			1910-1930			1898-1932		
	M	*F*	*T*	*M*	*F*	*T*	*M*	*F*	*T*
0- 1	20.1	22.6	21.3	30.6	23.7	27.2	7.9	9.8	8.8
1- 4	10.1	7.7	8.9	20.8	19.3	20.0	10.5	9.4	9.9
5- 9	2.4	3.6	3.0	6.9	6.4	6.6	8.4	9.8	9.1
10-14	2.9	2.4	2.6	4.2	4.7	4.4	7.5	7.1	7.3
15-19	6.5	8.3	7.4	5.6	7.1	6.4	10.0	8.5	9.3
20-24	7.1	5.9	6.5	4.2	6.1	5.2	13.4	12.0	12.7
25-29	4.7	4.2	4.5	2.8	3.7	3.2	7.5	7.6	7.6
30-34	3.5	3.6	3.5	1.7	3.0	2.4	7.5	8.0	7.8
35-39	1.8	4.8	3.3	0.7	3.0	1.8	1.7	2.7	2.2
40-44	2.4	2.9	2.6	2.4	3.0	2.7	5.4	4.5	5.0
45-49	4.7	1.8	3.3	2.1	2.0	2.0	6.3	5.8	6.0
50-54	7.1	4.8	6.0	1.0	1.7	1.4	2.9	3.6	3.2
55-59	4.7	3.0	3.9	2.4	1.3	1.8	2.1	2.2	2.2
60-64	7.1	5.9	6.5	2.8	2.0	2.4	3.3	3.1	3.2
65-69	5.9	5.9	5.9	3.1	2.4	2.8	2.5	2.7	2.6
70-74	3.0	2.4	2.7	4.2	2.7	3.4	.04	.09	.06
75-79	2.4	3.6	3.0	3.5	4.4	4.0	.08	.09	.09
80-84	2.4	4.2	3.3	0.7	2.0	1.4	.04	.01	.02
85-89	0.6	1.2	0.9	0.3	0.7	0.5	.08	...	.04
90+	0.6	1.2	0.9	0	0.3	0.1	.04	...	.02

The tabulated data are presented in Table 1. We have added the data for the Mohave (Clements) and Seminole (Krogman) to facilitate comparisons. It appears that the 0-1 and 1-4 year death rates for the Dakota are higher than for the other groups (Figure 1).

Clements states that his data for this period are incomplete; on the other hand the Dakota register bears evidence of being complete in this respect. For example, still-births were recorded. However, all the Dakota rates are higher than those given by Clements, until the 15-19 age, after which they tend to be lower. Since this is a matter of relative frequency, the differences would probably have been less had early deaths been completely reported for the Mohave. Krogman also

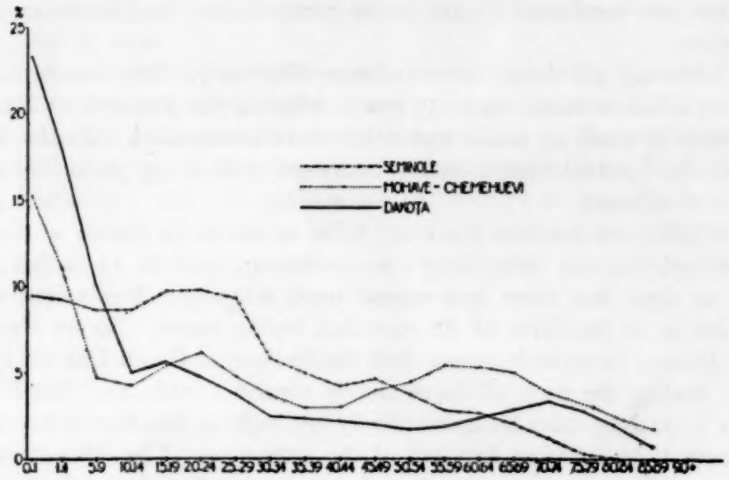

FIG. 1. CURVES FOR AGES AT DEATH, SEMINOLE, MOHAVE-CHEMEHUEVI AND DAKOTA INDIANS
(THE TOTALS IN TABLE 1 WERE ROUNDED OFF TO SMOOTH THESE CURVES.)

was of the opinion that among the Seminole the data for early periods were incomplete. So we suspect that the Dakota curve for 0-15 years is nearer the normal.

However, ignoring these differences, the three curves are of the same form approximately until the 40th to 45th years. They show a peak for 15-20 which Clements assumed distinctive of Indians in general.

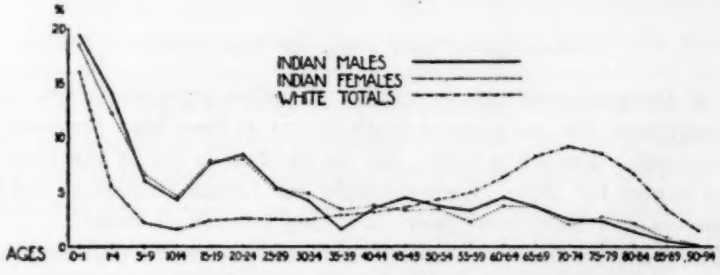

FIG. 2. AGE-AT-DEATH CURVES SHOWING RACE AND SEX DIFFERENCES
(THE GRAND TOTALS FOR EACH SEX IN TABLE 1 WERE USED IN PLOTTING THESE CURVES. THE TOTALS FOR THE WHITE RURAL POPULATION ARE FROM CLEMENTS.)

This is now confirmed insofar as the Seminole and the Dakota are true samples.

After 45 all three curves behave differently. The Dakota curve shows a flat tendency until 55 years, whereas the rise sets in for the Mohave at about 45 years, and is far more accentuated. On the other hand the Seminole curve shows its second peak at 45 years, but then trails downward.

Finally, we combine the three tribal series as in Figure 2, and so smoothed out, the curve shows an undoubted peak at 15-24 but it is not so clear that there is a second peak at 45-65. This raises some doubts as to the form of the so-called Indian curve. So we checked our Dakota curve with census data for Indians of South Dakota(1930-32), finding the form of curve closely similar (Table 4). North Dakota (1924, 27, 28) occupied chiefly by Indians less homogeneous in culture, is less similar, but still of the same type. The differences we note are that our data present higher rates for 0-4 years which again we interpret as indicating that the census reports omit many infant deaths.

Krogman's Seminole curve differed most from our Dakota curve. We find his curve is not in close agreement with the census data for Indians of Oklahoma of which the Seminole are a part. Since the Seminole were seen to be most divergent, they appear here as not even typical of Oklahoma Indians.

Clements' curve, when compared with Arizona Indians as a whole, does not agree very well, but is more like New Mexico Indians. What is suggested here is that there are significant regional and tribal differences in the age-at-death curves for Indians.

CHANGES IN THE FORM OF THE CURVE

The foregoing and certain studies of Indian populations now under way suggested that such age-at-death curves as have been presented are not constant. The white curve, for the present, is not of the form one would expect for 1870. Unfortunately our Indian records do not lend themselves to comparisons over such long periods of time.

The group studied by Clements seems to have been a declining population. In 1910 the United States record gives this population as 1334 and in 1935 as 1148. Krogman's Seminoles are listed as 3000 in 1900, 2132 in 1906 and 2141 in 1928. Thus since 1906 this population appears stationary. The Dakota group reported upon in this paper, had

a population of 744 in 1909, and 928 in 1929. The increase was steady from year to year.

In our studies of Indian populations, we found the Blackfoot of Canada declining steadily from 1890 to 1929, since which date they show a tendency to gain. For their tribe we have no data as to ages-at-death but we can divide the population into minors (0-20) and adults (See Table 2). For comparison we list minors and adults for the Dakota, a growing population, and for the Blood (close relations of the Blackfoot) who lost population from 1894 to 1919, since which date they have gained at an accelerating rate.

TABLE 2

Minors and Adults Per Thousand Population

TRIBE	DATE	MINORS	ADULTS
Blackfoot.....	1894	436	564
	1914	441	559
	1929	441	559
Dakota.....	1909	468	532
	1929	507	493
Blood	1894	407	593
	1919	495	505
	1934	544	456

The declining population (Blackfoot) shows no certain change in the relative number of minors between 1894 and 1929; the growing population (Dakota) shows a steady increase in the number of minors. The population (Blood) reversing from a period of loss to one of gain, shows an equality of minors and adults at the turning point, suggesting that a gain in minors is an important factor in population increase. We assume that such progressive gains in minors would be reflected in the age-at-death curves if plotted annually. The Dakota data can be divided according to periods but the numbers then become small. (Table 3). Yet there are obvious differences in trend.

Though we note that at the turning point in population decline minors and adults are about equal and that with increasing population

TABLE 3

Distribution of Ages At Death Per Thousand Population—Dakota

AGES	1910-1915	1924-1929
0- 4	532	436
5- 9	36	44
10-14	39	58
15-19	43	60
20-24	38	63
25-29	31	42
30-34	23	33
35-39	21	35
40-44	25	37
45-49	17	39
50-54	31	22
55-59	24	14
60-64	34	13
65-69	22	23
70-74	24	31
75-79	19	28
80-84	20	17
85+	18	6

minors gain, it would be unwise to generalize. Other tribes may present contradictory results. However, the suggestion is that among Indian populations of this type, trends in age groups may be expected which in turn could modify the age-at-death curves. We give these examples in support of the assumption that the Indian age-at-death curve is not constant in form.

Clements suspected that tuberculosis accounted for the large number of Indian deaths under 20 years of age. An intensive study of this disease among the plains tribes of Alberta and Saskatchewan was made by Ferguson.[2] He found the peak in the tuberculosis age death curve

[2](a) R. G. Ferguson, Tuberculosis among the Indians of the Great Canadian Plains. Pp. 51. Reprinted from *Transactions of the 14th Annual Conference of the Nat. Assoc. for the prevention of Tuberculosis.. London,* no date.

(b) Some light thrown on infection, etc. Reprint, *Transactions Amer. Clinical and Climatological Assoc.,* 1934. pp. 9.

(c) The Indian tuberculosis problem and some preventive measures. Reprint, *Trans. of the 29th Ann. Meeting of the Nat. Tuberculosis Assoc.,* 1933, pp. 14.

progressing from early childhood to adult life. Thus, the maxima of deaths from tuberculosis were as follows:

1887-1906	0-5 years
1907-1926	10-14 years
1927-1932	15-19 years

Insofar as tuberculosis determines the age-at-death curve it would follow that its form would change with the years. Ferguson assumes that the above tabulation plots the course of a disease in a virgin population, thus regarding the phenomenon as not peculiar to Indians. He calls attention to the 1931 maximum mortality among the white population of Saskatchewan as falling between 25 and 29 years. Further evidence is given to support the view that though the Indians studied are still far behind whites, the trend since 1887 has been toward the white incidence. In the main Ferguson[3] would agree with Clements that tuberculosis is an important factor, but suggests that its effect upon the age-at-death curve would vary from time to time.

Incidentally, data upon changes in total death rate among Indians upon reservations were compiled by Ferguson.[4] The approximate extremes in annual rates for four agencies were:

Period	*Death Rates*
1883-1892	20-137
1893-1902	30-100
1903-1912	25-70
1913-1922	13-78
1923-1926	18-48

This shows that the total death rates reached a high level around 1890. The highest tuberculosis death rates were found in the interval 1885-1892. We call attention to these additional observations because they support the assumption that the age-at-death curves are not constant, but will vary from period to period.

SEX DIFFERENCES

Sex differences as shown in the tables are not striking, but have been commented upon by both Krogman and Clements. However, we

[3]Ferguson (c) p. 4
[4]Ferguson (a) p. 10

call attention to one characteristic which all three tribal groups have in common; the tendency for males and females to follow each other closely in fluctuations which might seem accidental. Thus we note in the table that when one sex swings upward the other does likewise and the reverse. For example, the Dakota curve goes sharply up at 15-19 for both sexes; down at 50; the Mohave sharply up at 15-19 (Table 1). This must mean that the causes making for changes in death rate at specific ages operate upon the two sexes about equally. The data used extend over a period of years so that the causes for these changes in death frequencies must have been in part age selective.

Perhaps we can approach an understanding of this by noting if age coincidences occur in the fluctuations of all groups. In the 35-39 age

TABLE 4

Age at Death Frequencies U. S. Census—Indians

AGE	1927-1928 N. DAKOTA		1930-1932 S. DAKOTA		1927-1928 ARIZONA		1929-1932 N. MEXICO		1928 OKLAHOMA	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
0- 1	257	216	200	188	255	235	331	275	137	149
1- 4	174	136	126	135	185	198	138	156	103	117
5- 9	36	52	49	34	34	59	25	30	24	20
10-14	40	52	39	60	60	90	33	21	10	40
15-19	51	73	77	70	79	69	55	43	66	57
20-24	20	63	56	48	56	56	38	80	64	62
25-29	40	28	35	33	26	26	33	59	56	47
30-34	32	28	40	31	24	28	32	37	37	45
35-39	12	31	22	36	24	28	28	29	51	42
40-44	24	21	19	30	26	20	17	29	42	42
45-49	32	17	13	23	24	33	33	21	34	40
50-54	44	31	35	28	29	21	42	34	74	27
55-59	40	4	43	33	18	11	20	22	56	40
60-64	20	45	36	39	21	23	26	35	29	45
65-69	44	49	33	44	35	15	32	19	22	32
70-74	55	28	42	48	23	21	32	32	54	40
75-79	40	35	46	42	23	16	26	19	44	47
80-84	28	31	48	33	24	26	16	19	42	40
85-89	11	21	19	22	11	8	14	18	15	30
90-94	0	35	10	14	8	13	22	13	29	32
Unknown	0	4	12	9	15	4	5	9	11	6

interval the tendency in the three curves is to reach a low turning point (Table 1). The drop and the reaction are abrupt for males. Females show a downward swing in each group, lagging behind somewhat, but reaching low points at 35, 45, and 55 respectively. Both sexes react upward sharply at 15-19, females tending to lead. Ferguson shows that more females than males die of tuberculosis at this period.

Perhaps the most striking sex peculiarity is for males to reach a low death rate at 35-39. Females tend to fall here also but do not reach the low level of males (Table 1). The census data for Indians in Arizona and North Dakota show the same peculiarity; for Oklahoma Indians the same sex differences appear for 30-34 years and in New Mexico for 40-44 years (Table 4). For Negroes of Oklahoma, Louisiana and Mississippi (1928) the low level for males is at 30-34 years; females have a higher rate. The same tendency is not observable in white death rates, but from 20-40 years all age rates are higher for females.

CONCLUSIONS

The new data for a Dakota community of Indians give an age-at-death curve which differs somewhat from those previously published. All three curves are similar in form for the interval 10-40 years and for later years they are, at least, in contrast to white death rates.

Evidence was presented to suggest that the forms for such curves are not constant because dependent upon the mode of life in the group. We found local differences in the census data for both Indians and Negroes which seemed to correlate with economic and social differences.

We feel that the data in hand justify the assumption that there is no specific form of age-at-death curves peculiar to either Indians, Negroes or Whites, as such. In respect to Indians it would follow that whenever their modes of life closely parallel that of the white people around them, their age-at-death curve will approach the white type.

CHANGES IN SYSTOLIC BLOOD PRESSURE, HEART RATE, AND TEMPERATURE BEFORE, DURING, AND AFTER PREGNANCY IN A HEALTHY WOMAN*

BY GEORGENE H. SEWARD AND JOHN P. SEWARD, Jr.
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I. PROBLEM

THE results of previous investigations in this field are frequently inconsistent and difficult to interpret. Two prevalent sources of difficulty are insufficient measures on the same subjects and lack of control data, particularly measurements before pregnancy. In the present study an attempt was made to avoid these defects by taking daily records before, during, and after pregnancy on a healthy woman, together with similar records on a male control.

II. METHOD

Subjects:—The experimental subject (ES) was a multipara (Para II) 32 years old. The control subject (CS) was a healthy male undergoing the same professional and domestic routine as ES. Although the control data were analyzed in the same way as the experimental, they will be referred to only where interpretation requires.

General Conditions:—The experiment covered the period from September 29, 1933 to November 12, 1934, inclusive. Daily records were made during this time totaling 416 experimental days. A few of these records had to be discarded because of indisposition not connected with pregnancy, leaving 397 records for ES and 402 for CS. The first day of the last menses occurred November 23, 1933. The most probable date of conception, determined by vaginal smears, was Decem-

*The writers are indebted to J. P. S. III, without whom this study could not have been done.

ber 5, 1933. Parturition occurred September 5, 1934. Thus the duration of the gestation period calculated from conception was 273 days; calculated from the onset of the preceding menses, 286 days.

Pregnancy was clinically normal, the subject maintaining a full-time teaching and research schedule during the academic year and research work daily until the day of parturition. Confinement was at home. Labor was normal in duration and difficulty, with spontaneous delivery. During the second stage nitrous oxide was administered in analgesic doses, with ether at the end. The baby was a normal female weighing 3.14 kilograms. She was fed artificially from birth and the mother's breasts dried. Recovery was uneventful and normal activities were resumed by the twelfth day.

Procedure:—All measurements were made with the subjects recumbent. The records of ES were under basal conditions after a night's sleep before rising or eating. The subjects acted as experimenters for each other, and in this way each was kept largely ignorant of his own records.

Systolic blood pressure was determined by the auscultation method using a Tycos mercury-column sphygmomanometer with the cuff around the subject's right arm. Readings were also taken at the beginning of the fourth phase to indicate diastolic pressure, but the authors do not regard these as reliable. There were many cases in which this point was too indefinite to be determined with certainty. We were interested to note the statement by King and Garrey (8) that "absolute diastolic readings by the auscultatory method are practically impossible."

Heart rate was determined by stethoscope.

Rectal temperature readings were taken with a calibrated clinical thermometer. The instrument remained inserted for a minimum of three minutes. During the first 10 days of the puerperium oral readings were substituted for rectal. Oral readings were later calibrated against rectal and the necessary correction made.

Vaginal smears were made daily by ES, who stained them according to Papanicolaou's method, described in detail in his recent monograph (9). The analysis of these smears will be presented in a forthcoming publication by Papanicolaou. In the present study the smears were used to identify the phases of the menstrual cycles and to determine the probable date of conception.

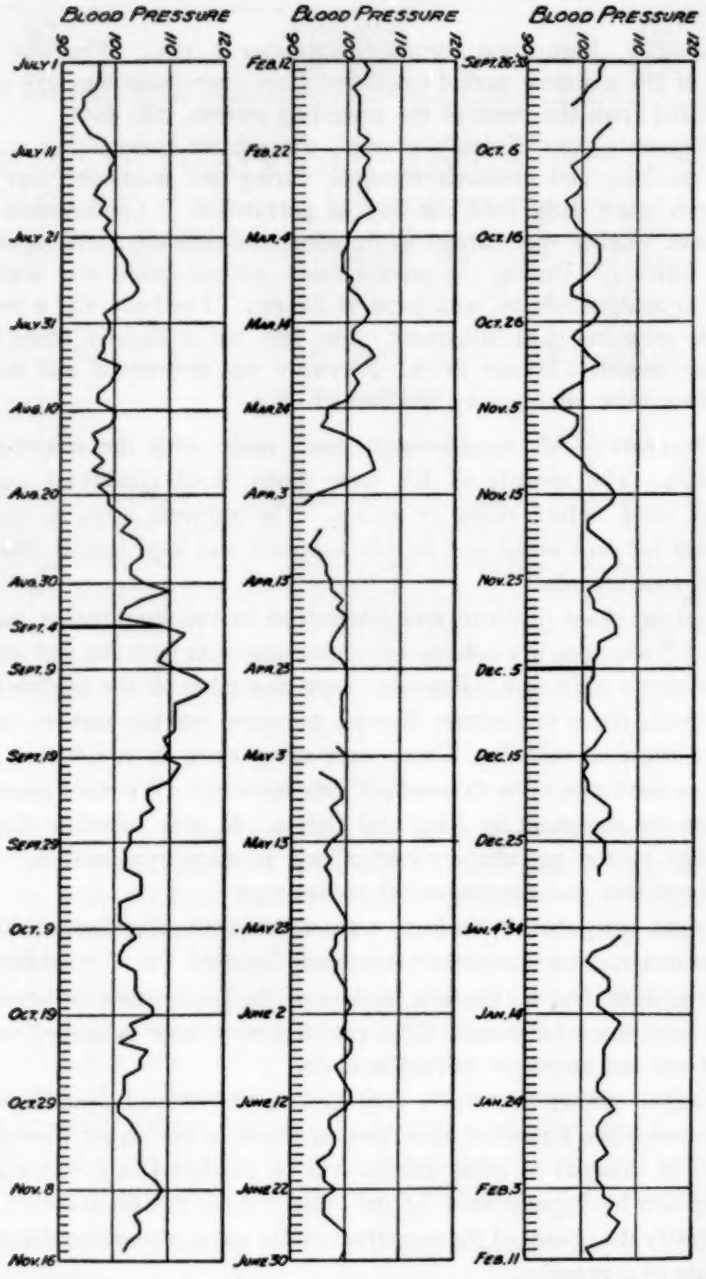

FIG. 1. THE COURSE OF SYSTOLIC BLOOD PRESSURE BEFORE, DURING, AND AFTER PREGNANCY. EACH DAY'S READING, IN MM. HG. HAS BEEN AVERAGED WITH THE PRECEDING AND THE FOLLOWING ONE. HEAVY VERTICAL LINES MARK THE DATES OF CONCEPTION AND PARTURITION.

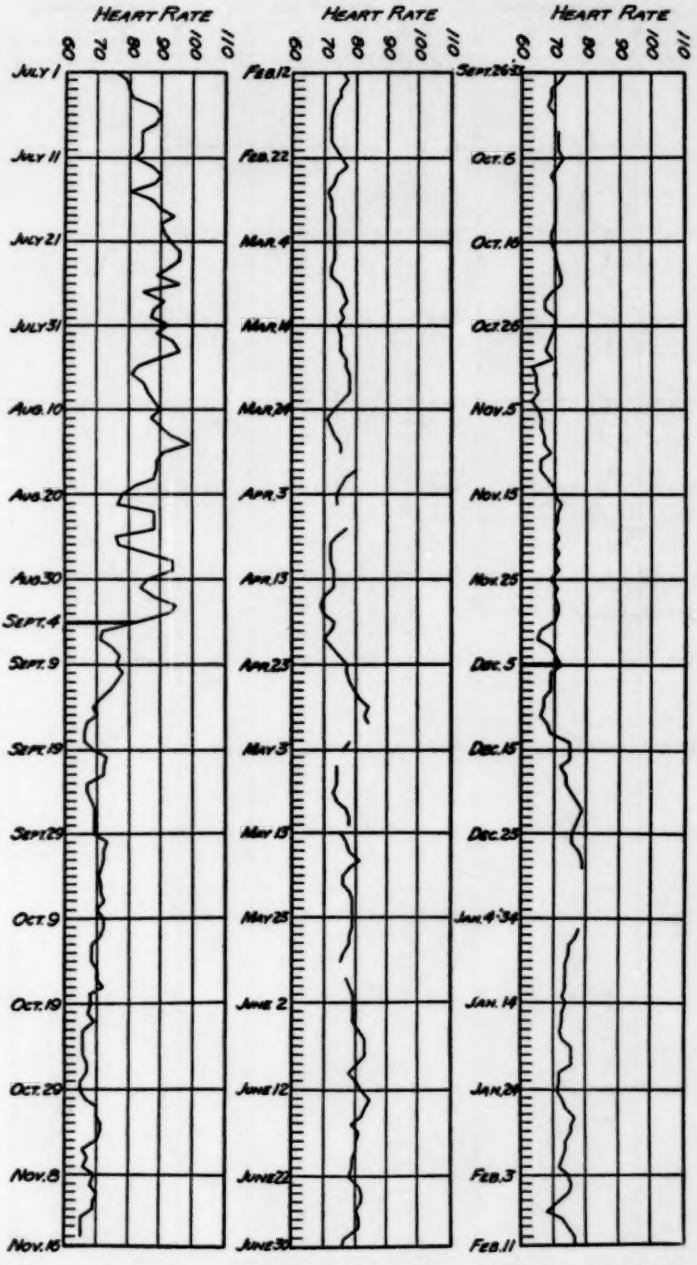

FIG. 1. (CONTINUED). SAME FOR HEART RATE IN BEATS PER MINUTE

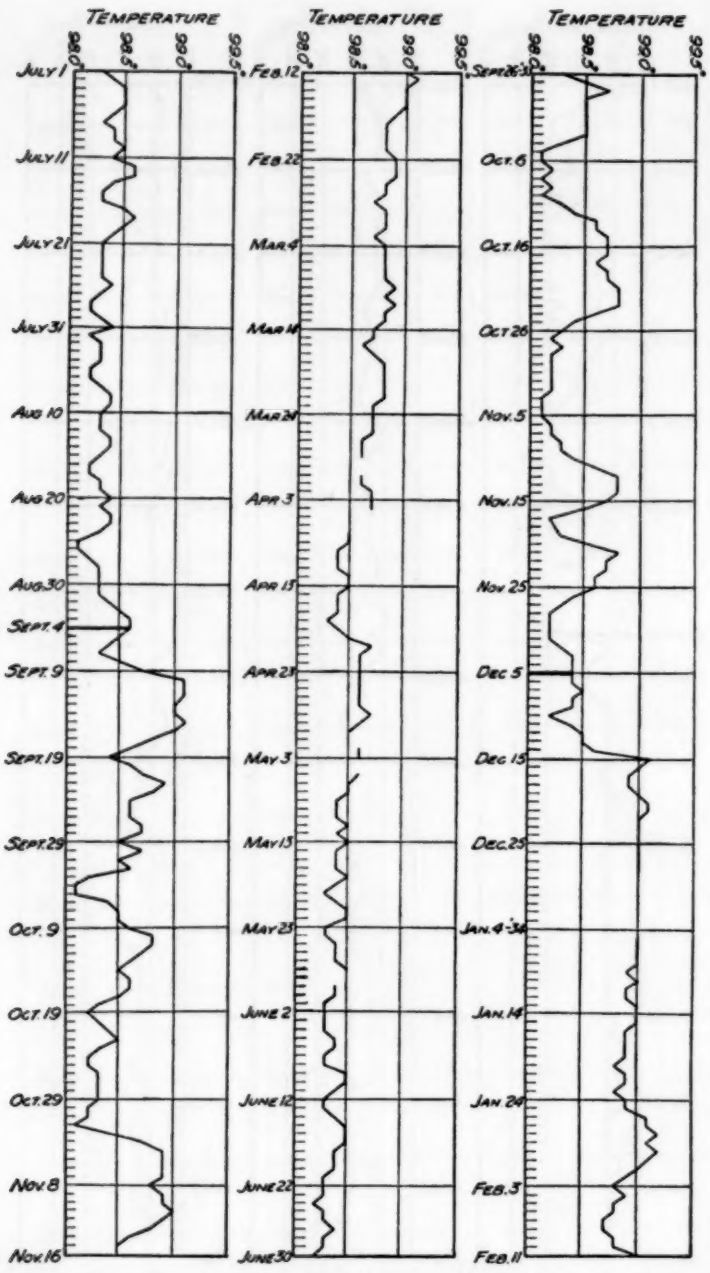

FIG. 1. (CONTINUED). SAME FOR RECTAL TEMPERATURE IN DEGREES FAHRENHEIT

III. RESULTS

In Figure 1 are plotted the daily scores of ES smoothed by Bloxam's method of averaging each score with the preceding and the following one. The dates of conception and parturition are indicated by heavy lines.

In grouping the data for statistical analysis, the menstrual cycle was selected as the unit for the non-pregnancy data and the time of pregnancy was divided into 10 periods of approximately 28 days each. The first period, however, included only the 15 days of an assumed 28-day cycle remaining after conception. The last period was also atypical in length, since it included the days in excess of 280. The puerperium was arbitrarily taken to include the 37 days between parturition and the ap-

TABLE 1

Averages and Standard Deviations for Approximate Four-Week Intervals

MENSTRUAL CYCLES	NO. DAYS	SYSTOLIC PRESSURE		HEART RATE		TEMPERATURE	
		Av.	S. D.	Av.	S. D.	Av.	S. D.
I	24	100.2	3.42	69.9	2.63	98.48	.276
II	30	100.9	3.97	67.7	3.59	98.47	.317
III ($\frac{1}{2}$)	13	103.5	2.73	69.7	4.27	98.36	.202
Pregnancy							
I	15	101.4	1.91	70.9	4.44	98.83	.218
II	22	104.3	2.70	75.8	3.15	98.98	.117
III	28	104.0	2.50	74.2	3.36	98.94	.186
IV	28	102.1	2.80	73.5	2.41	98.82	.129
V	25	98.8	4.91	75.0	2.99	98.64	.165
VI	26	98.4	2.62	74.9	4.79	98.52	.140
VII	27	98.7	2.39	78.0	2.87	98.40	.122
VIII	28	97.9	2.56	80.3	3.64	98.37	.147
IX	28	98.7	5.37	89.3	9.64	98.39	.205
X	34	100.4	5.78	87.7	10.80	98.32	.171
Puerperium	37	107.4	5.40	70.9	4.34	98.65	.355
Menstrual Cycles							
I	32	104.2	4.14	68.5	3.28	98.52	.305

pearance of the first menses. Table 1 presents the average scores and standard deviations in the three measures for each period.

The next step was to determine the reliabilities of the indicated trends. The need of adequate samples led us to divide pregnancy into thirds, or approximately 90-day periods. Each of these trimesters was compared with a norm consisting of the average of the two complete menstrual cycles preceding pregnancy and the first one following parturition. The standard errors of the differences were obtained and the critical ratios computed. These are presented in Table 2. It will be recalled that a ratio of three, indicating a difference three times as large as its standard error and representing a probability of 99.87 per cent is usually accepted as an index of complete reliability.

TABLE 2

Averages and Standard Deviations for Trimesters of Pregnancy with Critical Ratios of Differences from Norm

	AVERAGES				STANDARD DEVIATIONS			
	Norm	T_1	T_2	T_3	Norm	T_1	T_2	T_3
Syst. Press.....	101.9	103.2	98.8	99.2	4.27	2.79	3.50	4.62
$D/\sigma_{diff.}$	....	2.33	5.13	4.02	...	3.80	1.83	0.74
Heart Rate....	68.5	73.8	76.0	85.7	3.37	3.67	3.89	9.38
$D/\sigma_{diff.}$	....	9.85	13.56	16.54	...	0.79	1.32	8.11
Temperature...	98.49	98.90	98.55	98.36	.305	.177	.189	.177
$D/\sigma_{diff.}$	....	10.59	1.55	3.36	...	4.83	4.38	4.83

The main features of the charts and tables may be most concisely summarized as follows:

	Pregnancy			*Post Partum*
	early	middle	late	
Average				
Systolic pressure	slight rise	fall	slight terminal rise	sharp rise
Heart rate	rise	continued rise	sharp rise	sharp fall
Temperature	rise	gradual fall	continued fall	sharp rise

Variability				
Systolic pressure	fall	constant	sharp rise	gradual fall
Heart rate	constant	constant	sharp rise	sharp fall
Temperature	fall	constant	constant	sharp rise

In some cases similar treatment of the control subject's data also revealed statistically reliable trends. CS showed a significant increase of blood pressure in the last two trimesters. His heart rate decreased in the first trimester and increased in the third. These trends necessitate caution in attributing the changes in ES's data to pregnancy alone.

The changes in variability accompanying pregnancy suggest that normal variation may be bound up with menstrual periodicity. To test this hypothesis the three normal cycles were classified, by microscopic examination of the vaginal smears, according to the four recognized phases popularly designated as menstrual, postmenstrual, intermenstrual,

TABLE 3

Averages for Phases of Menstrual Cycle

CYCLE	MENSTRUAL		POST-MENSTRUAL		INTER-MENSTRUAL		PRE-MENSTRUAL	
	No. Days	Av.	No. Days	Av.	No. Days	Av.	No. Days	Av.
				Systolic Pressure				
I	6	101.2	5	100.4	3	97.0	10	100.4
II	8	100.9	5	97.8	4	98.3	11	102.5
III	10	103.2	10	103.0	4	105.3	7	106.7
Av.	..	101.8	..	100.4	..	100.2	..	103.2
				Heart Rate				
I	6	69.7	5	70.6	3	69.7	10	69.7
II	8	67.7	5	63.7	4	66.8	11	69.6
III	10	68.8	10	66.6	4	70.3	7	68.0
Av.	..	68.7	..	67.0	..	68.9	..	69.0
				Temperature				
I	6	98.40	5	98.18	3	98.37	10	98.72
II	8	98.29	5	98.16	4	98.25	11	98.77
III	10	98.46	10	98.29	4	98.70	7	98.90
Av.	..	98.38	..	98.21	..	98.44	..	98.80

and premenstrual. According to the "wave theory" of menstrual periodicity, we should expect a cyclic rhythm in physiological functions to be characterized by a premenstrual rise and a menstrual fall.

Table 3 shows the average readings for each of the three cycles and the averages of these. Inspection of the table reveals clear-cut cyclic changes in temperature, less definite ones in blood pressure, and none in heart rate. It is interesting to note that in a recent review of the experimental literature on the female sex rhythm Seward (16) found more uniformity among investigators in reporting positive results on temperature than on cardio-vascular changes. The differential susceptibility of the three measures to menstrual periodicity may possibly be explained in terms of relative stability. Heart rate and blood pressure are more easily affected by extraneous factors which tend to obscure cyclic changes, while temperature is more resistant to such effects. The wide deviations of the former measures in late pregnancy support this hypothesis.

IV. DISCUSSION

In the present experiment pregnancy was accompanied by an early rise in systolic pressure giving way to a lowered level. This reduction of level is in line with the findings of Cornell (1) and Hare and Karn (5). The rise in the last months reported by these investigators and by Roig (11), Simons and Rasmussen (17), Slemons and Goldsborough (18), Strassmann (19), and others (3) here appears only shortly before parturition. The most striking deviation was the raised level maintained for approximately 18 days *post partum*. This would align itself with the findings of Roig (11), who characterized the puerperium as a period of hypertension, rather than those of Strassmann (19), who was led to the opposite conclusion. The increased variability in the last two months of pregnancy recalls the increased lability of the blood pressure noted by Kehrer (7) and Schwarz (15).

The most striking of the changes revealed by the present study were the increased variability and the acceleration of the heart rate in the last months of pregnancy, followed by a sudden drop to approximate normality immediately after delivery. These results are similar to those of the subject studied by Sandiford and Wheeler (13). They confirm the frequently reported observation of a tendency toward tachycardia during pregnancy (4) (10) (17) and of a retardation after delivery (4) (5) (12). The former trend is often attributed to the mechanical

conditions of squeezing and displacement of the heart and the increased demands made upon it. In the light of a case of tachycardia and labile pulse in early pregnancy, apparently of toxic origin, Schubert (14) pointed out that similar conditions more frequently observed in the later stages might also indicate toxemia. Kehrer (7) reviewed a mass of evidence that the sympathetic nervous system shows increased irritability in pregnancy.

The rise of temperature which appeared in early pregnancy and again after parturition confirms the observation of Fruhinsholz (2). The former he attributed to the action of corpus luteum in women with unstable autonomic nervous systems. In the downward trend from the first to the third trimester our results agree with those of Sandiford and Wheeler (13), but not clearly in other respects. Conspicuous in our results was the reduced variability which characterized the entire course of pregnancy. Harvey and Crockett (6) have supplied convincing evidence of the effect of the menstrual cycle on body temperature. This, coupled with our analysis of the menstrual cycle data, points to the suppression of cyclic fluctuation as the most plausible explanation.

V. SUMMARY

Within the limits of this experiment:

1. Pregnancy was accompanied by an early rise and later fall in systolic blood pressure and body temperature and by an acceleration of the heart. Variability was reduced in temperature and systolic pressure and showed a late increase in systolic pressure and heart rate.

2. Parturition was followed by a sudden return to normal in heart rate and by a sharp rise with a gradual return toward the norm in the other two measures. Variability followed the same respective courses in heart rate and temperature, with a gradual decline in systolic pressure.

BIBLIOGRAPHY

1. Cornell, E. L. *Amer. J. Obstet. and Gynec.*, 18, 42, 1929.
2. Fruhinsholz, M. A. *Bull. Soc. Obstet. et Gynéc. Paris*, 18, 307, 1929.
3. Gallavardin, L. La Tension Artérielle en Clinique. 2nd Ed. *Paris*, Masson, 1920, Pp. 717.
4. Gewürz, M. *Arch. Gynäk.*, 152, 109, 1932.
5. Hare, D. C., and Karn, M. N. *Quart. J. Med.*, 22, 381, 1928.
6. Harvey, O. L., and Crockett, H. E. Hum. Biol., 4, 453, 1932.
7. Kehrer, E. Halban-Seitz' Biologie und Pathologie des Weibes. 6^2, 713, 1925.

8. KING, C. E., and GARREY, W. E. *Amer. J. Physiol.*, 85, 385, 1928.
9. PAPANICOLAOU, G. N. *Amer. J. Anat.*, 52, 519, 1933.
10. PERALTA RAMOS, A., and SCHTEINGART, M. *Gynéc. et Obstet.*, 15, 333, 1927.
11. ROIG, P. P. Y. *Rev. Argent. Obstet. y Ginec. Buenos-Aires*, Año 2, 483, 1918.
12. ROWE, A. W., GALLIVAN, D. E., and MATTHEWS, H. *Amer. J. Physiol.*, 96, 101, 1931.
13. SANDIFORD, I., and WHEELER, T. *J. Biol. Chem.*, 62, 329, 1924.
14. SCHUBERT, v. *Z. Geburtsh. u. Gynäk.*, 85, 593, 1923.
15. SCHWARZ, G. *Arch. Gynäk.*, 135, 133, 1928.
16. SEWARD, G. H. *Psychol. Bull.*, 31, 153, 1934.
17. SIMONS, E. J., and RASMUSSEN, C. C. *Minn. Med.*, 8, 303, 1925.
18. SLEMONS, J. M., and GOLDSBOROUGH, F. C. *Johns Hopkins Hosp. Bull.*, 19, 194, 1908.
19. STRASSMANN, E. *Arch. Gynäk.*, 132, 35, 1927.

THE INHERITANCE OF l-XYLOKETOSURIA (ESSENTIAL PENTOSURIA)

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THERE are at least two known types of chronic essential pentosuria, differing from each other in the nature of the pentose found, the one, dl-arabinose, the other, l-xyloketose. Using a simple new test (1) which facilitates the identification of l-xyloketose in urine, the authors have observed 41 cases of pentosuria of this type and have had an opportunity to study the transmission of the condition.[1] Herewith is presented some evidence which seems to indicate strongly that xyloketosuria is inherited as a recessive characteristic.

Urine pentose has been identified as dl-arabinose in the case of Salkowski and Blumenthal (2) [analysis by Neuberg (3)], in the cases of Aron (4), Wrzesnewski (5), and Cammidge and Howard (6). Levo-xyloketose is established as the urine pentose in the cases of Zerner and Waltuch (7), Levene and La Forge (8), Hiller (9), Greenwald (10), Hari (11), Enklewitz and Lasker (12) and is almost certainly the sugar in the case of Elliott and Raper (13). Dr. F. W. Sunderman, in a private communication, states that he has identified the sugar as l-xyloketose in a pentosuric family which he has studied recently. In most of the reported cases of pentosuria the exact nature of the sugar was not determined.

Many familial cases of pentosuria have been found and it has become common practice to state that pentosuria should be expected to behave as a Mendelian recessive character (14). af Klercker (15), whose cases were probably xyloketosuric, found two brothers having pentosuria in a sibship of seven, all of whom were tested; both parents as well as two children of a normal brother were negative. Levy and Pierson (16) tested 17 members of a family

[1]We are indebted to Drs. William G. Exton, Ernst Mueller, J. Rogoff, Aaron Feldman, Arthur Bookman, M. M. Levitas, Alter Weiss and Victor H. Kugel for specimens of pentosuric urine from individual cases, to Dr. Alvin Shaye for the urine of the two cases and for the data in Figure 11, and to Dr. Abraham Rudy for the specimens of five cases and the data in Figures 17 and 18.

and found two great-aunts and a great-uncle of their original case were excreting pentose. Jones and Nissler (17) found four children and a grandmother positive for pentose and another sister and the mother negative; the father was tested and gave a doubtfully positive test on one occasion. Cammidge and Howard's (6) cases were father and son in one family and uncle and nephew in another. In addition, familial cases occurring in siblings have been reported by Bial (18), Brat (19), Janeway (20), Rosenbloom (21), Fischer and Reiner (22) and Hari (11). Newman (23) observed the brother of a case reported elsewhere in the literature and Janeway mentioned that Bendix's (24) case was familial, but we have not found the evidence.

Instances of l-xyloketosuria as well as of dl-arabinosuria occur in these familial cases. The urinary pentose has been identified as dl-arabinose in Cammidge and Howard's (6) cases, whereas the two sisters and a brother in the family reported by Hari (11) were shown to excrete xyloketose.

Twenty pentosuric families have been observed by us and are depicted in Figures 1 to 20. The urine pentose of 37 individual members has been identified as l-xyloketose by the dl-osazone method of Zerner and Waltuch (7) and by the new test developed by the authors (1).

Cases of pentosuria.

Urine tested and found free from pentose.

Urine reported to be free from sugar.

Urine not tested.

EXPLANATION OF FIGS. 1-20

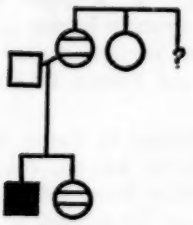

FIG. 1

EVIDENCE FOR RECESSIVE INHERITANCE

Four facts indicate that l-xyloketosuria is inherited and is probably controlled by a single recessive gene.

I. Xyloketosuria is very rare in the general population but is frequently found in the families of known cases.

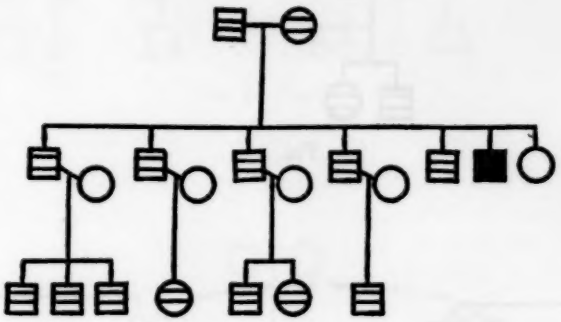

FIG. 2

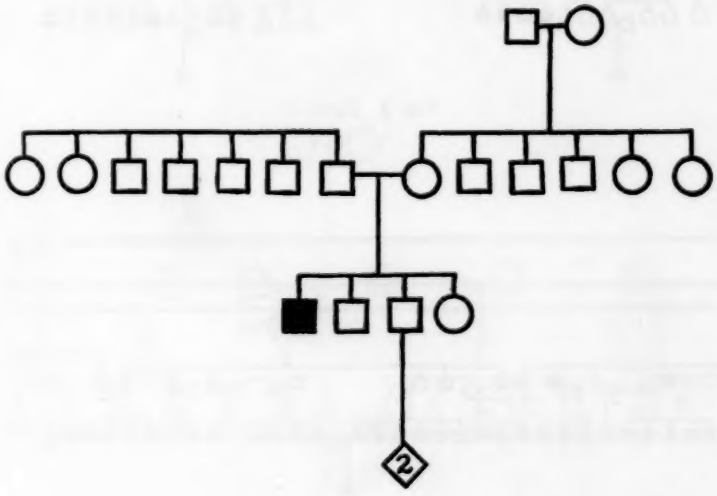

FIG. 3

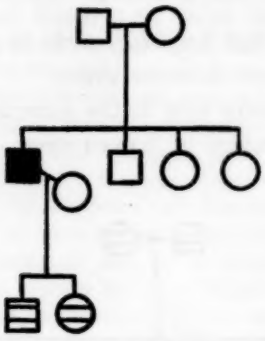

FIG. 4

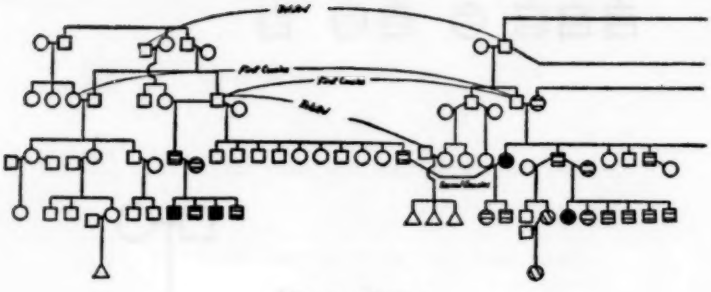

FIG. 5 PART 1

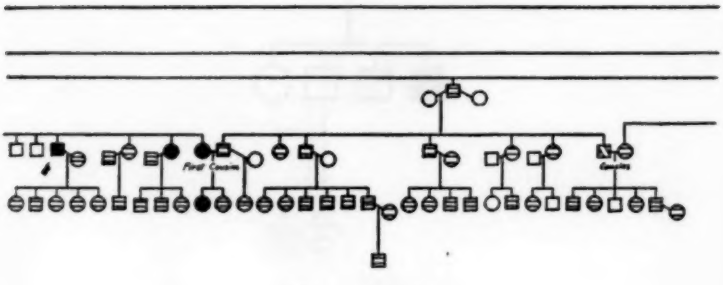

FIG. 5 PART 2

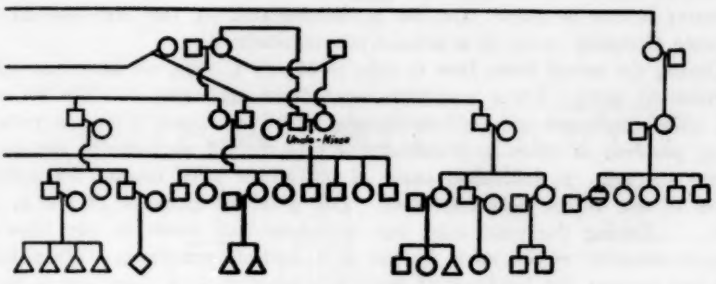

FIG. 5 PART 3

FIG. 6

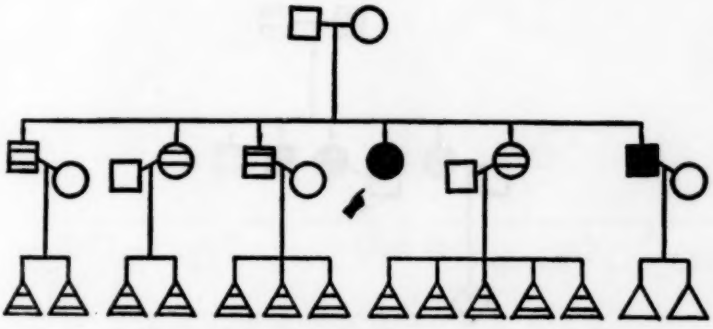

FIG. 7

Margolis (25) reviews studies of 22,000 urines; in these the incidence of pentosuria is one in 2,000. Dr. N. R. Blatherwick of the Metropolitan Life Insurance Company states in a private communication:

"During the period from June 6, 1934 to March 1, 1936, we examined 130,985 specimens of urine. These specimens were from applicants for life insurance, home office employees and field employees. 8,318 specimens giving a reduction of 0.25 per cent or more by Benedict's picrate method were tested for pentose by your method. 31 individual cases of pentosuria were found,[1] not including a sister of one of our field employees. This gives an incidence of one in 4,225 cases.....During the year 1935, one urinalysis was made in our laboratory for approximately eleven made by the field medical examiners. When this is taken into account, the incidence of pentosuria appears to be about one in 50,000."

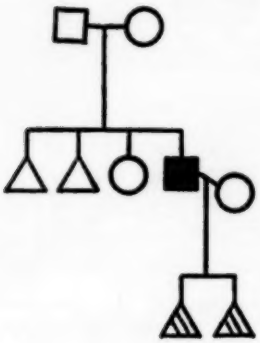

FIG. 8

FIG. 9

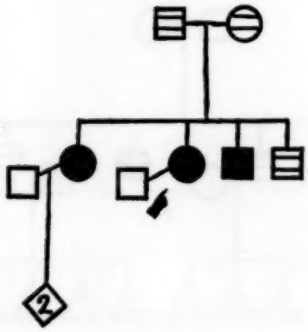

FIG. 10

[1] The urine of these cases gave Lasker and Enklewitz's (1) test for xyloketose and Bial's test for pentoses.

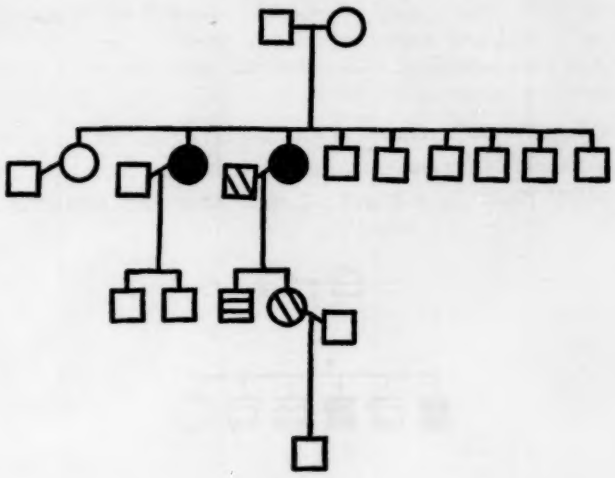

FIG. 11

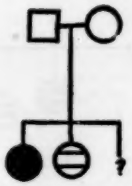

FIG. 12

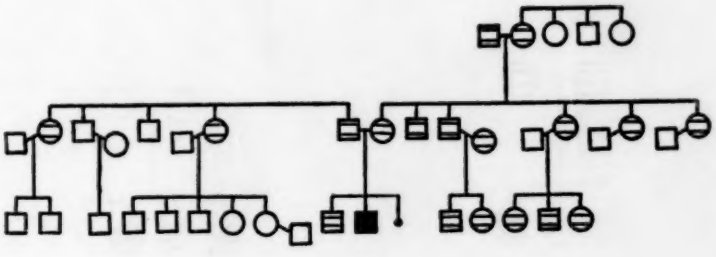

FIG. 13

Dr. Blatherwick realizes that he probably missed many instances of pentosuria among those cases which showed less than 0.25 per cent of reducing substance. Our own experience shows that the concentration of reducing substances is sometimes below 0.25 per cent.

As for family occurrence, on the other hand, we have tested 34 brothers and sisters of xyloketosuric propositi and found ten new cases (not including those in Figures 17 and 18). In one great family

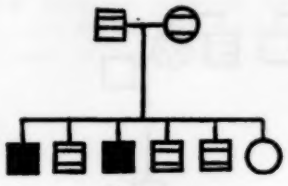

FIG. 14

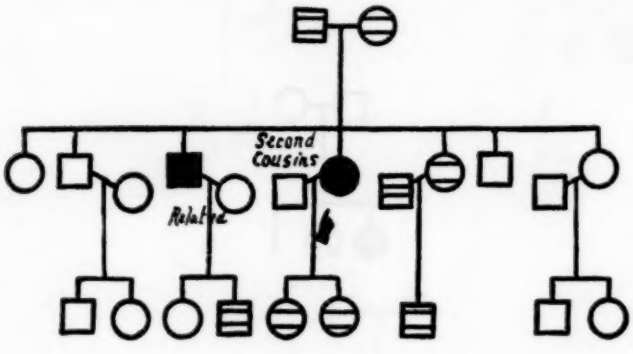

FIG. 15

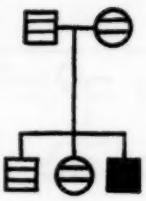

FIG. 16

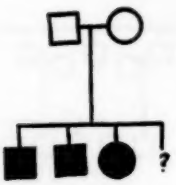

FIG. 17

FIG. 18

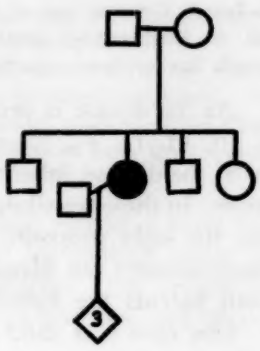

FIG. 19

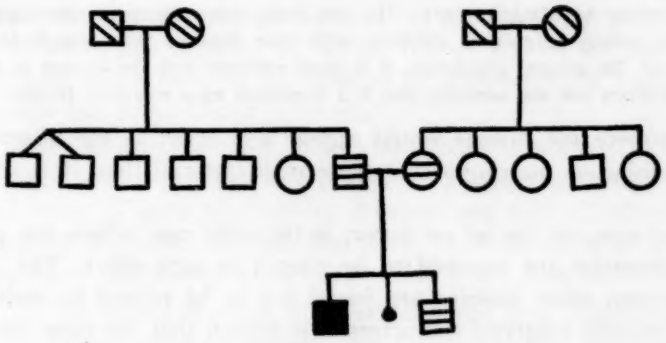

FIG. 20

(Figure 5) we have tested urines of 66 individuals and found seven additional cases of pentosuria.

II. Most cases of pentosuria are among Jews, a fact which strongly supports the contention that the disease is hereditary. Revising and bringing the figures of Margolis' (25) review of race distribution up to date, we find in the literature that 75 cases including 35 of ours are Jews; in 65 cases including six which were referred to us no mention of race is made.

Besides two Greek and two English arabinosurics observed by Cammidge and Howard, one of Koopman's (26) cases is stated to be not a Jew and not of Jewish descent. Dr. Stephen K. Mayer has told us that he found pentosuria

in a non-Jewish German, one of his patients. Judging from the names, most, if not all, of Blatherwick's pentose urines were from Jews. No instance of xyloketosuria has yet been reported in a non-Jew.

III. As the disease is present in children of ten families (Figures 2, 5, 9, 10, 13, 14, 15, 16, and 20) in which neither parent shows evidence of the disease, inheritance, if operative, would almost certainly be recessive. In these ten sibships, 16 out of 38 members had pentosuria; deducting the eight propositi, there remain eight out of 30 members, which approximates the Mendelian ratio for a recessive characteristic when both parents are hybrids.

IV. One case is a child of first cousins (Figure 5). The likelihood of members of her generation in her family showing the trait is very great if xyloketosuria is to be considered as a recessively inherited anomaly, both because one parent has the disease and because the parents are related to each other.

According to Macklin (*27*): "If one finds consanguineous marriages more frequent among parents of children with rare diseases than one finds among parents of the general population, it is good evidence that the disease in question is a hereditary one and secondly that it is dependent upon recessive factors."

Furthermore the disease would appear less often in the offspring of consanguineous marriages if it were multifactorial than if it were recessive.

Our case, so far as we know, is the only case where the parents of pentosurics are reported to be related to each other. The parents of fourteen other sibships are found *not* to be related to each other. In recessively inherited characters it is known that the rarer the character the more frequent the consanguinity of parents. We think it worth noting that among Jews, where most if not all of the xyloketosurics have been found, the anomaly is not so very rare. If cases are found among non-Jews where the incidence is probably much smaller, one might expect a much higher per cent of consanguinity of parents than is to be found in Jewish cases.

DISCUSSION

A. There is an apparent preponderance of males having pentosuria.

Margolis (*25*) reviewed the literature and found 48 males and 25 females. Since then 71 males and 26 females have been reported, including 23 males and

17 females from our cases and the 31 males and one female observed by Blatherwick, making the totals 119 males and 51 females.[3]

Margolis stated that many pentosurics were discovered at the examinations for life insurance where no doubt more males presented themselves. This consideration would apply to the great preponderance of males found by Blatherwick. Even aside from insurance examinations, urinalysis is more apt to be made on apparently healthy males than on females.

Because of the possibility of preselection playing a more important part in adults, the literature was reviewed for children under 15 years of age. This age limit was chosen arbitrarily. The review disclosed 17 boys and eight girls including six boys and one girl observed by the writers.

By the method of brothers and sisters the preponderance of males is not found. From 23 brothers of propositi we examined, four new cases were found, while from 14 sisters examined six cases were found. Among other relatives tested we found two female pentosurics and two male. Conversely, though we seem to have a fairly even distribution of males and females, 23 of the former and 17 of the latter, yet the cases which came to our door were preponderantly male. We had 14 male and seven female propositi.[4]

B. The incidence of twins is very important in a study of hereditary mechanisms. The full significance of a single instance of non-identical twins (Figure 9) (28) of different sex both of whom have xyloketose in the urine will manifest itself from the point of view of the hereditary mechanism when further cases are reported.

C. In the identified cases of dl-arabinosuria both familial occurrences are in successive generations, the father and son, and the uncle and nephew, found by Cammidge and Howard (6). If arabinosuria is inherited there is a possibility of a dominant mechanism being in control. On the other hand, however, Aron (4) stated that the immediate family of the five-year-old arabinosuric boy he observed was

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[3]In the totals are eight males and two females established as arabinosurics. Of the cases we consider to be xyloketosurics, 46 are males, 22 females.

[4]Fortuyn (31) has suggested that hare-lip, which appears twice as often in males as in females, might be explained by the hypothesis that the trait is inherited as a double recessive, one gene being autosomal and the other one sex-linked. In the families with xyloketosuria which we have examined there is more evidence that the inheritance is determined by a single gene lying in an autosome. In the absence of more cases this can only be a hypothesis but a more tenable one than the above.

negative. If Aron tested both parents a simple dominant mechanism could not be in control.

D. Other causes than heredity may produce pentosuria. Many cases of an alimentary type have been reported. Cases of acquired chronic pentosuria and of toxic pentosuria according to Margolis (25) and Protas (29) are brought on or aggravated by infections or nervous trauma or other toxic factors. We think it possible that the pentosuria had been overlooked and was only discovered after the pentose excretion had increased following the administration of drugs (30).

SUMMARY

A study of 20 families in which are 37 cases of xyloketosuria indicates that the condition which permits or causes l-xyloketose to be excreted in the urine is inherited as a simple recessive anomaly.

BIBLIOGRAPHY

1. Lasker, M., and Enklewitz, M.: *J. Biol. Chem.*, 1933, 101, 289.
2. Salkowski, E., and Blumenthal: *Ztschr. f. physiol. Chem.*, 27, 507-539.
3. Neuberg, C.: *Ber. d. deut. chem. Gesell.*, 1900, 33, 2243.
4. Aron, H.: Einfall von Pentosurie im frühen Kindesalter, *Monatschr. f. Kinderheilk.*, 1913-1914 (Orig.) 12, 177-184.
5. Wrzesnewski, A. N.: Research on the pentaglycose in a new case of pentosuria, *Biochem. Ztschr.*, 1922, 132, 135-137.
6. Cammidge, P. J., and Howard, H. A. M.: Seven cases of essential pentosuria, *Brit. Med. J.*, 1920, 2, 777-779.
7. Zerner, E., and Waltuch, R.: Bemerkungen über den Zucker in Pentosurieharn, *Biochem. Ztschr.*, 1913-1914, 58, 410-412.
8. Levene, P. A., and La Forge, F. B.: Note on a case of pentosuria, *J. Biol. Chem.*, 1914, 18, 319-327.
9. Hiller, A.: Identification of a pentose in a case of pentosuria, *J. Biol. Chem.*, 1917, 30, 129-134.
10. Greenwald, I.: *J. Biol. Chem.*, 1930, 88, 1.
11. Hari, P.: *Biochem Ztschr.*, 1930, 224, 474.
12. Enklewitz, M., and Lasker, M.: Studies in pentosuria, *Am. J. Med. Sci.*, 1933, 184, 539.
13. Elliott, J. H., and Raper, H. S.: Note on a case of pentosuria presenting unusual features, *J. Biol. Chem.*, 1912, 11, 211-215.
14. Garrod, A. E.: Inborn Errors of Metabolism, *London*, Henry Frowde and Hodder and Stoughton, 2nd ed., 1923.
15. af Klercker, Kj. O.: Studien über die Pentosurie, *Stockholm*, 1904. (Monograph).

16. LEVY, D. J., and PIERSON, M.: Pentosuria, *Am. J. Dis. of Child.*, 1927, 33, 213-217.
17. JONES, H. W., and NISSLER, C. W.: Pentosuria, report of five cases in one family, *Annals of Clin. Med.*, 1925-1926, 4, 505-509.
18. BIAL, M.: Die chronische Pentosurie, *Berl. Klinik*, 1907, 226, 1.
19. BRAT, H.: Beitrag zur Kenntnis der Pentosurie in der Pentosen-reaktion, *Ztschr. f. klin. Med.*, 1902, 47, 499-506.
20. JANEWAY, T. C.: Essential pentosuria in two brothers, *Am. J. Med. Sci.*, 1906, 132, 423-428.
21. ROSENBLOOM, J.: Essential pentosuria in a brother and sister, *J. Am. Med. Assn.*, 1923, 80, 250.
22. FISCHER, A. E., and REINER, M.: Pentosuria in children, *Am. J. Dis. of Child.*, 1930, 40, 1193-1207.
23. NEUMAN, L.: The practical aspects of pentosuria, *Med. Ann. of Dist. Columbia*, 1932, 1, 79-82.
24. BENDIX, E.: Ein Fall von Pentosurie, *München. med. Wchnschr.*, 1903, 50, 1551-1552, and Die Pentosurie, *Stuttgart*, 1903. (Monograph).
25. MARGOLIS, J. I.: Chronic pentosuria and migraine, *Am. J. Med. Sci.*, 1929, 177, 348-371.
26. KOOPMAN, J.: Pentosuria, *Geneeskundige Bladen*, 1924, 24, 1-24.
27. MACKLIN, M. T.: The role of heredity in disease, *Medicine*, 1935, 14, 1.
28. ENKLEWITZ, M., and LASKER, M.: Pentosuria in twins, *J. Am. Med. Assn.*, 1935, 105, 958.
29. PROTAS, M.: Pentosuria, *Southern Medicine and Surgery*, 1934, 96, 154.
30. ENKLEWITZ, M., and LASKER, M.: The origin of l-xyloketose, (urine pentose), *J. Biol. Chem.*, 1935, 110, 2.
31. FORTUYN, A. B. D.: Inheritance of hare-lip and cleft palate in man, *Genetica*, 1935, 17, 349-366.

THE BIRTH ORDER OF MONGOL AND OTHER FEEBLEMINDED CHILDREN

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SINCE Langdon-Down[1] in 1866 first described Mongolism in his attempt to provide an ethnological classification of the mentally defective, much attention has been given to the study of this particular form of feeblemindedness. Among the genetic factors that have been considered are the size of the family in which the Mongol is found, and the place in the family occupied by the affected child.

The first report on the birth order of Mongols was made by Mitchell in 1876 in some notes contributed along with a paper by Fraser.[2] It appears from Mitchell's data that his cases show a tendency to be born late in the family, but this fact is not emphasized particularly. As early as 1886 Shuttleworth[3] said, "It is remarkable that, in our experience, nearly half these children are the last born of a large family." Shortly afterward statements that Mongols were frequently the last born of large families were made by Robert Jones,[4] by Langdon-Down[5] himself, and by Telford Smith.[6]

A lengthy review of the subsequent literature on this question does not seem necessary. Brief quotations from two recent studies will show that the matter is still in dispute. Still[7] has said of the cases he studied, "These figures demon-

[1] Langdon-Down, J. Observations on an ethnic classification of idiots, *London Hospital Reports,* 1866, 3, 259-262.

[2] Fraser, J. Kalmuc idiocy: Report of a case with autopsy, With notes on sixty-two cases, By A. Mitchell, *J. Ment. Sci.,* 1876, 22, 169-179.

[3] Shuttleworth, G. E. On idiocy and imbecility, *Brit. Med. J.,* 1886, 1, 183-186.

[4] Jones, R. The mouth in backward children (imbecile) of the Mongolian type, *J. Ment. Sci.,* 1890, 36, 187-190.

[5] Langdon-Down, J. Article on Forms of Idiocy, A Dictionary of Psychological Medicine, edited by D. Hack Tuke, *London,* 1892.

[6] Smith, T. The thyroid treatment of cretinism and imbecility in children, *Brit. Med. J.,* 1896, 2, 616-618.

[7] Still, G. F. Place in family as a factor in disease, *Lancet,* 1927, 213, 795-800, 853-858.

strate what has long been recognized as a clinical fact, that the late born child is for some reason specially liable to Mongolism." On the other hand Macklin[8] at the conclusion of an extensive study says, "The Mongolian idiot tends to occur in each place in the family in the same proportion that the population as a whole occurs in these places, showing that there is no greater liability for the Mongol to be born at the end of a large family than there is for it to appear at the beginning or middle of it." It should be said, however, that the statistical analysis of Schulz[9] has gone far to destroy the cogency of Macklin's argument.

SELECTION OF FEEBLEMINDED GROUP

The present investigation is an attempt to study the birth order of 124 Mongols examined in the Psychological Clinic of the University of Pennsylvania from 1914 to 1934, and to compare the birth order of these Mongols with that of an equal number of feebleminded children not of the Mongol type examined during the same period. It seems convenient to refer to these two groups as the Mongol group and the feebleminded group, although of course it is to be understood that the Mongols are feebleminded. Approximately two thousand non-Mongol feebleminded children were examined during this period, and from these the feebleminded group of 124 cases was selected in the manner about to be described.

Since Mongols generally represent the more profound degrees of mental deficiency, the feebleminded group was made up of children whose deficiency was rated as that of a low grade imbecile on the Barr Classification or lower. The accumulated evidence on the problem shows that while in a few instances more than one Mongol may be born in a family, this occurs very infrequently. In no case in our group did we find more than one Mongol in the same family. Consequently the feebleminded group was made up of cases in which the affected child was the only feebleminded child in its family. It must be noticed therefore that certain types of familial feeblemindedness are excluded from the feebleminded group. We are thus dealing with a somewhat restricted group of feebleminded children but one which may for that reason be more directly comparable with the

[8] Macklin, M. T. Mongolian idiocy: the manner of its inheritance, *Amer. J. Med. Sci.*, 1929, 178, 315-337.

[9] Schulz, B. Zur Genealogie des Mongolismus, *Zsch. f. d. ges. Neur. u. Psychiatr.*, 1931, 134, 268-324.

Mongol group. While not all of the siblings of these feebleminded children were examined, only those cases were used in which it appeared from the case history and from the parents' report that there were no other feebleminded children in the family. The records showed that 26 of the siblings of the feebleminded children had died. Many of them died in infancy and it is not possible to make a judgment of their mental status. The inclusion of these cases, however, probably leads to less error than the selection of feebleminded children from families in which no children have died. In the Mongol group 34 dead siblings are reported.

Since Mongols are likely to be recognized earlier than other feebleminded children because of their distinctive physical appearance and their pronounced retardation in development, for example in beginning to walk, it is important that the two groups be equal in chronological age. With each Mongol there was paired a feebleminded child which did not differ from it in age by more than six months. In most cases the difference was very much less. The cases ranged in age from 2 years to 24 years with a median age of 7 years.

Several accidental correspondences occurred in the two groups. Each was composed of 66 males and 58 females. Three pairs of twins were found in the families of the Mongols, and three pairs in the families of the feebleminded. In compiling the results these were counted as single births. In determining the birth order of the affected children, still births and miscarriages were counted as births.

BIRTH ORDER

What we mean by 'birth order' is really order of pregnancy, and in the following discussion this is to be understood. It is difficult to secure accurate information concerning miscarriages, partly because mothers are reluctant to divulge such information, and partly because in some cases the recollection of the mothers is very uncertain, particularly in large families. In the Mongol group 28 miscarriages are reported: in 10 families, one miscarriage; in 4 families two miscarriages; in one family, three miscarriages; and in one family seven miscarriages. It is interesting to note that in this last family there were no children born except the Mongol; one miscarriage occurred before the Mongol was born and six after it was born. In the feebleminded group 6 miscarriages are reported: in 4 families, one miscarriage; in one family,

TABLE 1

Number of Mongols Born in Each Birth Position in Families of Given Size

FAMILY SIZE	BIRTH POSITION													
	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th	14th	Total
1	16														16
2	7	22													29
3		9	13												22
4	1	1	7	10											19
5	3		1	3	4										11
6					2	5									7
7						2	4								6
8		1				2		1							4
9								2	1						3
10										3					3
11															
12												2			2
13															
14										1				1	2
Total	27	33	21	13	6	9	4	3	1	4		2		1	124

TABLE 2

Number of Feebleminded in Each Birth Position in Families of Given Size

FAMILY SIZE	BIRTH POSITION														
	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th	14th	15th	Total
1	24															24
2	19	16														35
3	9	13	10													32
4	3	3	3	2												11
5		2	2	2	3											9
6	1			1												2
7					2	1	3									6
8								1								1
9							1		1							2
10								1								1
11																
12																
13																
14																
15															1	1
Total	56	34	15	5	5	1	4	2	1						1	124

two miscarriages. It will be noticed that there are more than four times as many miscarriages among the families of the Mongol group as among the families of the feebleminded group. This difference is so great as hardly to be accounted for by errors in the source of information.

Tables 1 and 2 show the birth order of the affected children in the two groups. An examination of these results shows at once that in the Mongol group there is a very pronounced tendency for the Mongol to be born late in the family. For example, 29 of the Mongols were found in families of two children; in 7 cases the Mongol was first born, in 22 cases it was second born. Again, of the 22 Mongols occurring in families of three children, none was first born, 9 were second born, and 13 were third or last born. It is true that among the 11 cases occurring in families of five children, 3 were first born, but this seems to be the only highly exceptional instance. Among the cases found in larger families of six or more children, we find only one which does not occur late in the family. This is the case referred to before in which the Mongol was the only child born, its birth being preceded by one miscarriage and followed by six miscarriages. It is to be remembered that in the presentation of the data and in the calculations miscarriages are counted as births. We may notice finally that, of the 79 Mongols occurring in families of more than two children, there are only 10, or 13 per cent, who are not either last born or next to last born in their respective families.

In the feebleminded group, on the other hand, we find a somewhat different situation. For example, of the 35 cases occurring in families of two children, 19 are first born, and 16 second born. Of the 32 cases occurring in families of three children, 9 are first born, 13 are second born, and 10 are third or last born. In general we may say that among the smaller families in the feebleminded group the affected children are distributed in a manner not different from that expected by the operation of chance. In the larger families of the feebleminded group, however, this does not seem to be the case. The number of cases occurring in the larger families is small, but in these few families the affected children seem to be late born just as the Mongols are. Of 11 cases found in families of seven or more children, all are born quite late in the family.

We may summarize the foregoing observations by saying that in the Mongol group the affected children tend to be born late in the

family, whether the family be large or small. In the feebleminded group the affected children are distributed as if by chance in the smaller families, while the few which occur in large families are born late.

APPLICATION OF χ^2 TEST

The validity of these observations can now be tested by more accurate statistical methods. If families of only one child are excluded, we find in the Mongol group 108 families, each containing an affected child. In these families there are a total of 480 children, each of which can be described, first, as affected or not affected, and second, if we divide equally the children born in the mid-position of families having an odd number of children, as born in the first half of its family or in the second half of its family. Of the 108 affected children, 18 are born in the first half of their families, and 90 in

TABLE 3

Affected and Not Affected Children in First Half and Second Half of Family

	AFFECTED		NOT AFFECTED		TOTAL
	Obs.	Exp.	Obs.	Exp.	Obs. & Exp.
A. Mongols					
1st half	18	54	222	186	240
2nd half	90	54	150	186	240
Total	108	108	372	372	480
$\chi^2 = 61.936$					
B. Feebleminded					
1st half	44.5	50	135.5	130	180
2nd half	55.5	50	124.5	130	180
Total	100	100	260	260	360
$\chi^2 = 1.676$					

the second half. If birth order of Mongols were a matter of chance, we would expect half the affected children, that is, 54, to be born in the first half of their families, and an equal number to be born in the second half. Thus we can construct Table 3 which shows the observed and the expected results for affected and not affected children in families containing Mongols. The results are such that the distribution is not likely to be considered a chance one. We can test the probability that such a distribution might occur by chance by the use of the χ^2 criterion[10]. The formula is $\chi^2 = S\left(\frac{x^2}{m}\right)$ where m is the expected frequency and $m + x$ the observed frequency. For these results in the Mongol group χ^2 proves to be 61.936. When $\chi^2 = 6.635$ the probability that the results might occur by chance is .01. With $\chi^2 = 61.936$ the probability is of course very much less.

TABLE 4

Affected and Not Affected Children in First Half and Second Half of Two- to Five-Child Families

	AFFECTED		NOT AFFECTED		TOTAL
	Obs.	Exp.	Obs.	Exp.	Obs. & Exp.
		A. Mongols			
1st half	17	40.5	110.5	87	127.5
2nd half	64	40.5	63.5	87	127.5
Total	81	81	174	174	255
		$\chi^2 = 39.968$			
		B. Feebleminded			
1st half	44.5	43.5	83	84	127.5
2nd half	42.5	43.5	85	84	127.5
Total	87	87	168	168	255
		$\chi^2 = .07$			

[10] For interpretation of χ^2 see Fisher, R. A., Statistical Methods for Research Workers, *Edinburgh*, Oliver & Boyd, 5th ed., 1934, p. 80 ff.

In the feebleminded group there are 100 families when families of only one child are excluded. The observed and expected results for this group corresponding to the results already given for the Mongol group are shown in Table 3B. The fraction in the observed results arises from the division of cases occurring in the mid-position of families containing an odd number of children. Here x^2 is 1.676. The probability that these results might occur by chance is approximately .20. The difference between the Mongol and feebleminded groups is quite evident. At the same time it is possible that the results for the feebleminded group are not entirely the result of chance. It has been seen that in the larger families of the feebleminded group there is a tendency for the affected children to be born late. Table 4 shows the results when larger families are eliminated, that is, including families of two, three, four and five children. For the Mongol group χ^2 is 39.968, and for the feebleminded group it is .07. The probability that results such as those found for the Mongol group would occur by chance is still less than .01, while the results for the feebleminded group are almost certainly due to chance. It can be concluded therefore that Mongols tend to be born late, even in small families.

TENDENCY TO BE LAST BORN

Our results can further be considered with respect to the tendency of affected children to be born not only in the second half of their families, but to be born absolutely last regardless of family size. Of the 480 children in the 108 families of the Mongol group considered in Table 3 each child is either affected or not affected, and also either last born or not last born. Since there is one affected child in each family, and of course one last born child in each family, we can say of the entire number of 480 children that 108 or 22.5 per cent are last born and 108 or 22.5 per cent are affected. If the percentage of last born among the affected were the same as in the entire group, we would expect 22.5 per cent of the 108 last born to be affected, or we may say that the expected number of last born affected is 24.3. However, the results as tabulated in Table 5A show that 66 of the last born are affected. Corresponding results for the feebleminded group are shown in Table 5B.

TABLE 5

Affected and Not Affected Children Last Born and Not Last Born

	AFFECTED		NOT AFFECTED		TOTAL
	Obs.	Exp.	Obs.	Exp.	Obs. & Exp.
		A. Mongol			
Last born	66	24.3	42	83.7	108
Not last born	42	83.7	330	288.3	372
Total	108	108	372	372	480
		$\chi^2 = 119.142$			
		B. Feebleminded			
Last born	37	27.78	63	72.22	100
Not last born	63	72.22	197	187.78	260
Total	100	100	260	260	360
		$\chi^2 = 5.798$			

TABLE 6

Affected and Not Affected Children Last Born and Not Last Born, Families of Two to Five Children

	AFFECTED		NOT AFFECTED		TOTAL
	Obs.	Exp.	Obs.	Exp.	Obs. & Exp.
		A. Mongol			
Last born	49	25.73	32	55.27	81
Not last born	32	55.27	142	118.73	174
Total	81	81	174	174	255
		$\chi^2 = 45.200$			
		B. Feebleminded			
Last born	31	28.11	56	58.89	87
Not last born	56	58.89	112	109.11	168
Total	87	87	168	168	255
		$\chi^2 = .658$			

These results may now be treated as were those in the previous tables. For the Mongol group χ^2 is 119.142, a figure which requires no comment. For the feebleminded group χ^2 is 5.798, the probability that the results found for this group might be produced by chance is .05. Factors other than chance may operate here, although we can not be so certain of this fact as in the case of the Mongols. When only families of two, three, four, and five children are considered, χ^2 is 45.200 for the Mongol group and .658 for the feebleminded group. The probability that the proportion of last born affected found in the Mongol group might occur by chance is still less than .01. In the feebleminded group the probability is between .30 and .50.

CONCLUSIONS

1. In families containing a Mongol there is a tendency, demonstrated to be statistically significant, for the Mongol to be born late in the family. This is true of smaller families containing from two to five children, as well as of the group as a whole.

2. In families of five or less children containing a feebleminded child, not of the Mongol type, the birth position of the affected child is a matter of chance. When all families in this group are considered, although the probability that the birth position of the affected child is determined by chance is diminished, it is still very much higher than in the families containing Mongols.

HAND SIZE IN WORKING WOMEN*

BY LEONA M. BAYER, M. D., AND H. GRAY, M. D.

TO study pathological peculiarities of build in disease, it is necessary to have standards in normals comparable to the run of patients in hospital and clinic. Since these could not be found for women, we published in 1934 such standards for body and head. Hand contours and measurements had also been made on 94 of the original women, and since then have been collected on 6 additional women selected according to the same criteria and belonging to the same decade as those replaced. The human hand has received frequent mention, but little close attention. It has been noted so often at the bedside, that certain endocrine disturbances are rather glibly predicted on the basis of suggestive appearance: the trident hand, tapering hand, etc. This is sound enough for those phenomena which make the patient more or less of a caricature. But for moderate degrees of variation from the average, a more precise approach is desirable; that is, existing meager measurements should be replaced by more complete standards for this organ.

MATERIAL AND MEASUREMENTS

For a detailed account of the selection of subjects, reference may be made to the 1934 paper. Suffice it to say here that they were working women, ranging in age from 20 to 60 years, that they were of North West European stock, that they were in good health and had a history of good health, that their menses were normal, that their weight was within 15 per cent of that predicted by the Medico-Actuarial tables, and that they had no history of obesity or of large weight fluctuations.

The close similarity of the present series of women with the 100 used in the build paper is sufficiently shown by the negligible differences between the averages for age, stature and weight in the two series.

* From Stanford University School of Medicine, aided by the Rockefeller Fluid Research Fund.

TABLE 1

TABLE OF CONSTANTS

Age: 36.23 ± .69 Years (20-60) N = 100

Working Women N.W.E. Stock Diagnoses: Normal

Measurements: Metric

Measurement		Mean ± PE		SD ± PE		CV
Ray I	I	126.020	.393	5.824	.278	4.621
Ray II	II	170.740	.552	8.184	.390	4.795
Ray III = Hand Length	HL	177.790	.556	8.237	.393	4.633
Ray IV	IV	168.600	.593	8.792	.419	5.215
Ray V	V	146.680	.506	7.508	.358	5.112
Finger Length	FL	91.680	.349	5.178	.247	5.648
Palm Length	PL	86.030	.305	4.526	.216	5.261
Hand Breadth	HB	81.150	.364	5.397	.257	6.651
Bi-Styloid Breadth	Bs	51.220	.169	2.500	.119	4.881
Hand Circumference	HC	188.640	.586	8.683	.414	4.603
Palm Circumference	PC	198.450	.640	9.492	.453	4.783
Wrist Circumference	Wr	154.790	.656	9.722	.464	6.281
Above named measurements in percent of Stature	I/S	7.798	.019	.277	.013	3.548
	II/S	10.507	.024	.351	.017	3.339
	HL/S	10.999	.024	.354	.017	3.220
	IV/S	10.430	.025	.366	.017	3.509
	V/S	9.079	.023	.339	.016	3.736
	FL/S	5.674	.015	.224	.011	3.948
	PL/S	5.867	.015	.229	.011	3.901
	HB/S	5.040	.017	.253	.012	5.012
	Bs/S	3.174	.010	.150	.007	4.726
	HC/S	11.700	.038	.560	.027	4.786
	PC/S	12.296	.038	.569	.027	4.624
	Wr/S	9.608	.037	.554	.026	5.766
Above named measurements in percent of Hand Length	I/HL	70.885	.111	1.649	.079	2.326
	II/HL	96.000	.080	1.187	.057	1.236
	IV/HL	94.720	.080	1.182	.056	1.248
	V/HL	82.550	.107	1.583	.075	1.918
	FL/HL	51.580	.086	1.274	.061	2.470
	PL/HL	48.400	.088	1.302	.062	2.690
	HB/HL	45.880	.147	2.182	.104	4.756
	Bs/HL	28.865	.093	1.380	.066	4.781
	HC/HL	106.325	.317	4.693	.224	4.414
	PC/HL	111.715	.345	5.116	.244	4.580
	Wr/HL	87.435	.333	4.932	.235	5.641

	Age in years	*Stature in mm.*	*Weight in k.*
1934.....	36.23±.69	1615.4±4.2	61.48±.49
1936.....	36.20±.70	1616.6±4.1	61.38±.49

The technique has been precisely described in our 1933 paper on Hand Method. The only changes from our original recommendations are the following: (1) The proximal landmark for hand length is carpale (ca), which is the midpoint of a line joining the tips of the styloids, and should have been so stated in the earlier paper, p. 402, line 14. (2) Palm length is a new item, derived by subtracting finger length from hand length.

The dimensions taken on the contour (cf. Figs. 7 to 9 in paper on Method) are: Hand length and ray lengths from carpale, hand breadth over the metacarpal prominences, and the now abandoned measurement over the bistyloid eminences. The dimensions taken on the subject directly are: Finger length from tip of mid-finger to base of the proximal phalanx (ph), bistyloid diameter at lateral bulges of the styloids with firm pressure, wrist circumference proximal to lateral bulges of the styloids with light pressure, hand circumference around metacarpal heads, and maximum palm circumference.

The raw data are too voluminous to be reproduced. The fundamental constants are shown in the Table of Constants (Table 1).

Comparable averages in the literature are few, owing to dissimilarities in racial origin and in method of measurement, but so far as found will be recited below, as the various traits are treated in the order of the table of constants.

ABSOLUTE DIMENSIONS

Hand Length (HL or Ray III)—The following evidence on American white women may be compared:

			N	*Mean*	*P.E.*
San Francisco	(Our data	1936).....	100	170.8	± .6
New York	(Draper	1930).....	331	171.8	
Cleveland	(Todd & Lindala	1928).....	36	171.8	±1.3
Smith College	(Wilder & Pfeiffer	1924).....	100	177.6	

The marked divergence of the last named is hard to explain. The larger sizes of Draper's and of Todd's series are contrary to expectation because they used as proximal landmark the radial styloid, which we found in our 1933 paper, p. 397, 400, to give a hand length about 3

millimeters shorter than measuring to the middle of the bistyloid line (carpale); however the difference is statistically without significance, so that the three averages agree remarkably.

Ray Formula—The ray formula is the order of relative length of the hand elements measured from carpale to the tips of the five fingers. Our values coincide with earlier series in showing the middle ray or hand length always the longest, and the thumb always the shortest. Three formulae are found. The commonest is III, II, IV, V, I; variants depend on the relative order of the index-ray II and ring finger-ray IV, whether it be II>IV, II<IV, or II=IV. Schultz confirms the usual formula in man, but states that II<IV is the rule in the gorilla. Wood Jones alone gives II<IV as the rule in man. The percentage frequency of the three formulae follows:

	San Francisco	*White adults (Schultz)*	*Germans (Pfitzner)*
II > IV.....	70	23	87
II < IV.....	18	18	13
II = IV.....	12	59	0

Regarding sex difference in the formula, Schultz 1926 wrote: "Most authorities agree that an index finger longer than ring finger is more frequent in women than men". That is, they consider the exceptional formula II<IV is commoner in males. On this sex question our evidence is at present insufficient.

Midfinger length (FL)—Our average of 91.7 mm.±.3 agrees sufficiently with 90.1 on the New York women, but is markedly less than 97 for Jews and 99 for Lithuanians given by Martin.

Hand breadth (HB)—The San Francisco women have broad hands: 81.2 mm., versus 76.3 for New York women and 69.7 for the Cleveland female cadavers (post-mortem desiccation),

Wrist circumference—Our mean 155 mm. was eleven percent bigger than 139 mm. found on Cleveland cadavers, presumably because of post-mortem shrinkage in the latter.

DIMENSIONS RELATIVE TO STATURE AND TO HAND LENGTH

Hand length (HL/S)—The length of the hand is known to increase with the increase of stature; r=.74 in the present series. For the index HL/S our result matches others well:

San Francisco	11.0
Smith College	10.8
Seven European races in Martin	10.8—12.2
Seven European races in Martin averaged by us	11.2

Hand breadth (HB/S)—Our result, 5.0 per cent, agrees exactly with that reported for Baden women by Martin.

Ray Lengths/HL—The relative lengths of the other rays to the central ray III of the hand (HL), expressed in percent of hand length, were:

V	IV	III	II	I
83	95	100	96	71

The only comparable value we find is in Schultz for the ratio between the thumb-ray I to hand length, namely 69, reasonably close to ours.

Hand Index (HB/HL)—Our women's hands were broader in relation to length, i.e.; index 45.9 percent, than in the groups found for comparison, namely: 45.6 in Baden women (Martin), 45.0 in "homo" (Schultz), 44.6 in New York women (Draper). Racial differences are said by Martin to consist in slender hands in Hamitic stocks, pygmies, eastern Asiatics and Jews, as against plump hands in Ainos, Letts and Lithuanians.

CORRELATION COEFFICIENTS

It is interesting to consider the relation of hand shape to body shape. Dolichomorphism of the hand is related to slenderness of the body in only a slight degree, according to Martin. For the present series we plotted the hand index against cephalic index (B/L), chest index (AP/T), facial index (MN/BZ), and relative pelvic bi-cristal diameter (BC/S). Not one of the four plots appeared good enough to merit calculation of the coefficient of correlation. Hand breadth and absolute bi-cristal diameter yielded an r of only .307.

Better results were obtained on correlating stature with the several lengths; with hand length $r=.740$, with finger length .707, and with palm length .591. Body weight was rather closely related to wrist circumference with $r=.667$.

Considering now the relation of some hand measurements to each other, the hand circumference around metacarpal prominences was

closely paralleled by maximum palm circumference, with $r=.887$. The palm circumference was larger in all cases but one, in which the girths were equal. The difference averaged about five percent; naturally if in any study, race or occupation (heavy manual exercise) should be thought to play a part, a greater difference between the two girths would be expected.

The wrist breadth (bi-styloid) as measured on the living and on contours of the same women's hands, yielded surprisingly poor correlation, $r=.527$; the explanation is partly the difficulty of locating the landmarks on the contour and partly the difference in pressure (nearer the bone in the living measurement). Since there seems little use for having two measurements of wrist breadth, and since our preference is for the bony breadth, the measurement on the drawing will be dropped in the future. This decision was confirmed by the fact that the standard deviation was significantly greater on the contour measurement, thus showing it to be more variable. The mean value for the bi-styloid breadth in the drawing was $57.4\pm.2$, whereas the bony measurement was 51.2 mm.$\pm.2$.

SUMMARY

Hand measurements have been made on 100 normal working women who were selected so as to be as homogeneous as possible with respect to the factors of economic status, age, racial stock, health and weight.

Comparisons are made with some other available values on Americans and Europeans. There are few such series, their averages differ in certain respects significantly, and they cover fewer traits.

The present standards now permit precise study of the hand of the American white woman whenever it be thought unusual in size or shape.

We have enjoyed the assistance of Messrs. D. R. Pratt, S. L. Rea, and Y. D. Wing.

BIBLIOGRAPHY

References to the authors discussed are given in our two recent papers:

BAYER, L. M., and GRAY, H. 1933. The hand: Method of measurement. *A. J. Phys. Anthrop.*, Vol. 17, pp. 379-415.

BAYER, L. M., and GRAY, H. 1934. Anthropometric standards for working women. *Human Biology*, Vol. 6, pp. 472-488.

BLOOD GROUPS OF TUNGUS

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THE problem of the racial significance of the blood groups still continues to attract the attention of the specialists. This may be seen in the lively discussion about blood grouping which took place in the section of Anatomy and Physical Anthropology of the First Session of the International Congress of Anthropological and Ethnological Sciences in London reported in one of the late numbers of *Nature*.

R. Ruggles Gates is quite right when he states that "there appear to be certain cases at least in which a knowledge of the blood grouping will throw light on the racial relationships." To confirm this opinion Gates and Darby (*Journ. Royal Anthrop. Inst.*, Vol. 64, 1934) show the data of blood grouping and physiognomy of British Columbia coastal Indians. Anthropologists have frequently pointed out that these tribes are more Mongoloid in appearance than other Amerinds. On the basis of the blood tests of 300 individuals the authors have proved that the British Columbia coastal Indians "are not a later Mongoloid wave but resemble other Amerinds in blood groups and other essentials."

THE RELATIONSHIP OF ASIATIC AND AMERICAN INDIAN RACES

This interesting work of the above mentioned authors raises a series of ethnological questions concerning the problem of the relationship of Asiatic races and American Indians. Owing to the lack of materials on isohaemagglutination of the Asiatic peoples this problem is rather difficult to solve by means of the serological method.

The general view of the origin and geographical distribution of the blood groups, though genetically sound, presented a certain difficulty when applied to the relatively non-crossed Amerinds and Eskimos. Both show a predominance of the I ($O_{\alpha\beta}$) blood group. But such O condition is generally regarded as the most primitive for the human race. However, a series of peoples more primitive than Amerinds and Eskimos does not show such a high percentage of the I ($O_{\alpha\beta}$) blood group. As an

example we may take the Australian aborigines of whom 678 persons tested gave the following result: I ($O_{\alpha\beta}$) 51.62 percent, II (A_{β}) 45.13, III (B^{α}) 2.51, IV (AB_{0}) 0.74 (from Tanemoto Furuhata, Value of Blood Grouping in Anthropology, 1933).

The solution of this problem may be found from the data of blood grouping of those peoples which are the most closely related to the American Indians and Eskimos.

Russian and American ethnographers and linguists have already paid great attention to the Paleasiatic group (Chukchi-Koryak-Kamchadal, Yukaghir-Chuvantsy, Eskimo-Aleut, Kets or Veniseians, Gilyaks) which are close to the American Indians in their culture and language. An eminent American anthropologist, A. Hrdlička, basing his conclusions on anthropological data obtained in North and Eastern Asia and on the Asiatic Islands, says that some of the tribes show a great resemblance in physical features to the American Indians. Hrdlička's attention was mostly attracted by the Tungus and especially by the south Tungus or at least some groups of them whose resemblance to American Indians was striking: "It is such a resemblance, in color, physiognomy and all features of the body, that we cannot but feel there must be here an identity of stock, and a unity in perhaps not a very far distant past" (*Science*, 1920, 52, No. 1355).

Hence we see what great anthropological interest the peoples of the North and especially the Tungus possess for the solution of important ethnological problems connected with the Northern coast of the Pacific Ocean.

But unfortunately data on the blood groups of the peoples of the extreme North, from the Ural mountains to the Pacific Ocean through the whole of Northern Siberia, are completely lacking, as is clearly seen in the schematic maps of Routil (*Biologia Generalis*, 1932, Vol. 8). This may be easily explained by the vast territory of North Asia, the sparse population of aborigines scattered through the tundra and tayga (northern forest) and the consequent great difficulty of communication.

Taking this into consideration the author has resolved to start with the collection of data on blood groups as well as on other anthropological features by investigating the students of the Institute of the Peoples of the North who every year come to Leningrad from the most remote and various parts of the European and Asiatic North from the Kola Peninsula to the Chukchi Peninsula and Kamchatka. This work began in 1927 and is still in progress.

The work is handicapped by the small and inadequate number of individual representatives of each of the 26 nationalities represented.

Investigations of blood groups ought to be done on a much more comprehensive scale.

BLOOD GROUPS OF THE TUNGUS

During these last eight years a sufficient number of observations (about 200 individuals) was obtained only on the Tungus-Manchurian group, especially on the Tungus, who call themselves Evenki.

Hrdlička's opinion about the similarity of the American Indians to the southern Tungus, whom he distinguishes from those of the North, was mentioned above, though it is not clear which of the nationalities he understood by the former and which by the latter. To be more specific, as is essential for this work, the author gives the division of the Tungus-Manchurian group now adopted by the Tungus linguists (J. P. Alkor-Koshkin). In Table 1 is also given the number of these nationalities according to the data of the Census of 1926-1927. If we take into consideration that the whole number of the peoples of the extreme North, according to the above mentioned Census, is 135,237, we may see that the Tungus-Manchurian group and among them the Tungus in the proper sense of the word are relatively the most numerous nationality.

TABLE 1

Population of Tungus-Manchurian Tribes in 1926-1927

NATIONALITY	NUMBER
a. *Tungus*	
1. Evenki (Tungus in the proper sense of the word)	38,804
2. Elkembeye (Neghidaltsy)	683
3. Eveny (Lamut)	2,044
b. *Manchu*	
1. Nanei (Golds, Samaghir)	5,860
2. Nanei (Ulchi, Oroki)	885
3. Ude	1,357
4. Nani (Orochi)	646
Total	50,279

The material given below on the blood groups concerns only the Tungus in the proper sense of the word (Evenki). They occupy the vast territory of Siberia from the Enisei River on the West to the coasts of

the Pacific Ocean on the East and from Taimyr Peninsula on the North to the Baikal Lake on the South.

The persons examined, mostly men of the ages of 19-23, came from 15 different districts of the East-Siberian Territory, 14 districts of the Yakut and Buryat-Mongolian Republics and 14 districts of the Far-Eastern Territory and Sakhalin.

The sera for this work were prepared in the Anthropological Department of the Museum of Anthropology and Ethnography of the Academy of Sciences and in the Bacteriological Laboratory of the All-Union Institute of Experimental Medicine. The sera were frequently verified on persons whose type of blood group (A and B) was known beforehand. Some students were tested repeatedly (2-3 times) with the same result. The macroscopical method was applied with two standard sera (A and B) and in some cases with three standard sera (A, B and O).

No difference was observed, either in the matter of the reaction itself or in its rate when compared to the investigations made on Europeans.

From Table 2 it is seen that the percentage of O group is very high (60.2 percent); the distribution of the A and B blood groups shows a Mongoloid type (A < B); the percentage of the AB blood group is small (2.7 percent).

TABLE 2

Distribution of Blood Groups among Tungus (Evenki)

TERRITORY	*N*	I ($o_{\alpha\beta}$)	II (A_{β})	III (B_{α})	IV (AB_{o})
All the districts	224	135	36	47	6
percent		60.2	16.1	21.0	2.7
East Siberian	54	32	6	15	1
percent		59.2	11.1	27.8	1.9
Yakut and Buryat Mongol-Republics	45	28	5	10	2
percent		62.2	11.1	22.2	4.4
Far East Territ. and Sakhalin.	46	27	10	8	1
percent		58.6	21.7	17.4	2.2

We divide our material into three groups, a western with the Evenki of the East Siberian Territory, a central with the Evenki of the Yakut and Buryat-Mongolian Republics and an eastern with the Evenki of the Far-Eastern Territory and Sakhalin. We have not complete data of the birthplace of all the persons examined, therefore the territorial groups are not so numerous as the whole material.

From Table 2 it is seen that all three territorial groups retain the high percentage of the O blood group. The Evenki of the western and central territorial groups show the relation $A < B$ whereas the Evenki of the eastern group have the reverse relation ($A > B$) with the same high percentage of the O blood group and a small percentage of the AB group. However, we cannot be sure of the significance of the blood group relation of the eastern Evenki in consequence of the paucity of the tested persons. Notwithstanding it is interesting to point out a certain similarity of their type of the blood group relation with the data received by Kishi on 62 Gilyak of Sakhalin who, however, show less percent of the O blood group (the Evenki, 58.6 percent; Gilyaks, 50.0 percent).

BLOOD GROUPS OF OTHER ASIATIC PEOPLES

The Evenki do not show any similarity in their blood group type with the other nationalities of Northern and Eastern Asia as is already proved by tests made on Ostyaks, Yakuts, Buryats, Mongols, Golds, Manchu, Chinese and Korean.

We find also no similarity with the island peoples such as Japanese, Ainu, Oroki, Igorotes (Philippines) and the tribes of Formosa with the exception of the Tso-o living in the interior mountains of Formosa, of whom 117 persons were examined by Kirihara and Haku, and the most isolated Ainu from the Lu Chu Islands, of whom 262 persons were examined by the same authors. They show a high percentage of the O blood group (the Tso-o, 63.3 percent and the Ainu 63.9 percent).

The Paleasiatics who have been examined by the author (*Proceed. 23rd Intern. Congr. Americanists,* p. 891, *N. Y.*, 1930), unfortunately only 33 individuals, also do not show any similarity to the Evenki in their blood group type.

BLOOD GROUPS OF AMERICAN INDIANS AND ESKIMOS

I cite here the summarized figures of Furuhata (1933) concerning the blood groups of American Indians in order to show their similarity to the Evenki in the high percentage of the O blood group. The 4,877 persons tested gave the following blood group distribution in percent: I ($O_{\alpha\beta}$) 77.7; II (A_{β}) 19.5; III (B_{α}) 2.3; IV (AB_{0}) 0.5. The comparison with the summarized figures for the Eskimos given by the same author presents a certain difficulty for me as most of the Eskimos tested in Greenland must have some European blood. The more pure-blooded "Polar Eskimos," of whom 124 were examined by Heinbecker and Pauli (1927) in the Thule district of northwest Greenland, show a very high percentage (80.7) of the O blood group.[1]

However, it is a very interesting fact that the Eskimos living near the mouth of the Mackenzie River of whom 16 were tested by Professor R. Ruggles Gates, have shown only 25 percent of the O blood group and a Mongoloid relation of the A and B blood groups (A—25 percent; B—44 percent).

The testing of the Asiatic Eskimos and those of Alaska as well as Aleuts and some of the Paleasiatics especially the Chukchi, Kets and continental Gilyaks is of high interest.

New materials on the blood grouping may throw a new light on the relationship of the aborigines of Siberia to the American Indians and Eskimos.

[1] I have the pleasure to thank Professor R. Ruggles Gates for his kindness in sending me the full compilation of the blood groups of the Eskimos.

THE PREDICTION OF STATURE OF NORTH EUROPEAN MALES THROUGHOUT THE ELEMENTARY SCHOOL YEARS[1]

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PURPOSE

IT HAS been shown (1), for a sampling of forty Iowa City white males, that the T-score or percentile position of an individual in his age group (for stature) fluctuates but slightly throughout the elementary school period and that, in consequence,

> the T-score or the percentile technique furnishes a reasonably refined instrument for predicting the stature of the individual Iowa City white male at eleven years of age from his stature measurement at six years of age. (1, p. 109)

The purpose of the present study was to test the finding of this preliminary investigation by applying the T-score method of prediction to a much larger sampling of North European males drawn from the elementary school population of Massachusetts.[2]

SUBJECTS

The subjects were 263 North European males in attendance at the public schools of Beverly, Medford, and Revere (three small cities

[1]The data analyzed in this paper were generously made available by Professor Walter F. Dearborn, Director of the Psycho-Educational Clinic, Graduate School of Education, Harvard University. Acknowledgment is also made to the growth study staff for their courtesy in facilitating use of the records.

[2]Parenthetically, it is of interest to note that the problem of this study coincides with one of the expressed objectives for the analysis of the Harvard growth study material. In a paper published prior to the writer's contact with the growth study staff, Lincoln stated that while the cumulative records on file at Harvard would not permit taking a series of measurements early in a child's life and using it for prediction of the child's status at a remote date, yet, "it should be possible to make tentative short-range predictions which will be of great value." (2, p. 10)

in the vicinity of Boston) during the years 1923-1928. Two methods had been used to determine the racial stock of the subjects. Initially the growth study staff had employed geographical and sociological criteria. Here, the main basis of classification had been the birthplace of the parents, but the language spoken in the home and the family name had also been used. The North European subjects as determined by this approach included "descendants from the old American stock together with more recent arrivals from the British Isles, Germany, Scandinavia, and the Baltic States, as well as English-speaking Canadians and Newfoundlanders."[3] It had been decided later to differentiate racial stocks in a strictly anthropological manner. Criteria involving nationality, language, and culture had here been abandoned and classifications made in terms of a combination of physical items such as skin pigmentation, facial features, eye and hair color, form of hair, type of build. The disagreements for the two methods of racial grouping had been found not to involve more than four per cent of the subjects (3, p. 7). The "North European" subjects of the present study were so classified by the method of the anthropologist.

MEASUREMENT TECHNIQUE

Stature measurements were made with a Model Martin No. 1 anthropometer. The anthropometer was mounted on a wooden box to which was attached a backboard 25 cm. wide and 185 cm. high. During measurement the subject stood erect on the base box of the anthropometer with heels together and arms hanging naturally at the sides. The heels, calves, buttocks, and shoulders were in contact with the backboard, and the head was so held that the visual as well as the biauricular axes were horizontal. The sliding arm of the anthropometer was brought down to the highest point on the top of the head with gentle but sufficient pressure to feel the resistance of the skull. Measurements were taken without shoes and determined to the nearest millimeter.[4]

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[3]Extract taken from an unpublished preliminary report of the Harvard growth study. Pp. 280 ms. (p. 12)

[4]From an unpublished preliminary report of the Harvard growth study. Pp. 280 ms. (pp. 18-19)

THE DATA

The data utilized in the present study consisted of 789 stature values on 263 North European males. These data represented stature values for the same 263 males at approximately seven, nine, and eleven years of age. They were obtained from the permanent record files of the Harvard growth study. The records were taken from the files in serial order and accepted for tabulation in every instance where stature values were available for a North European subject within each of the age ranges 6 years, 9 months to 7 years, 3 months; 8 years, 9 months to 9 years, 3 months; and 10 years, 9 months to 11 years, 3 months.[5] Each stature value taken from the permanent records represented the average of two stature measurements—one by each of two independent anthropometrists.[6]

METHOD OF PREDICTION

A T-score graph was constructed for each of the three age intervals within which the data were selected to fall. The method of constructing the T-score graph based on the 263 stature values distributed over the age interval 6 years, 9 months to 7 years, 3 months was as follows:

1. Tabulation of the values into a frequency distribution
2. Computation of the number of boys exceeding each class interval
3. Determination of half the frequencies falling within each class interval
4. Calculation of the per cent of boys exceeding plus half those reaching each interval
5. Reading of the standard deviation value corresponding to each per cent from Table 23 of McCall's text (5, pp. 274-5)
6. Plotting of the T-scores, using equidistant T units for the ordinate scale and class interval midpoints as the abscissa units

Comparable graphs were obtained from the 263 stature values at each of the ages 8 years, 9 months to 9 years, 3 months; and 10 years, 9 months to 11 years, 3 months by a similar procedure.

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[5] Since examinations had been made annually, the stature values for any given individual were evenly spaced, e. g. at 6 years, 10 months; 8 years, 10 months; and 10 years, 10 months.

[6] In the event that the two measurements had not agreed to within half a centimeter at the time they were taken, it had been the customary field practice to have them checked and obtain two independent observations within this margin.

The method of prediction was that of determining the T-score corresponding to the stature value for a given individual boy at seven years of age and then reading from the nine and eleven year graphs the respective stature predictions which were equivalent to this T-score. The predicted stature at nine years minus the stature value at nine years obtained from measurement gave the error of prediction for each individual over a two-year age span. The error of prediction over the four-year age period from seven to eleven years was obtained for each of the 263 boys by subtracting his observed stature at eleven from his predicted stature at that age.

FINDINGS

Distribution of the errors of prediction for the 263 North European males at nine years and at eleven years yielded the figures of Table 1.

TABLE 1

Distribution of Errors of Prediction of Stature

INTERVALS OF ESTIMATED MINUS OBSERVED DIFFERENCES	FREQUENCIES AT NINE YEARS OF AGE		FREQUENCIES AT ELEVEN YEARS OF AGE	
	NUMBER	PER CENT	NUMBER	PER CENT
Above +2.5 cm.	...	...	8	3.0
+1.6 to +2.5 cm.	9	3.4	31	11.8
+ .6 to +1.5 cm.	72	27.4	61	23.2
— .5 to + .5 cm.	113	43.0	83	31.6
— .6 to —1.5 cm.	56	21.3	54	20.5
—1.6 to —2.5 cm.	13	4.9	21	8.0
Below —2.5 cm.	...	...	5	1.9
Totals	263	100.0	263	100.0

Examination of the percentage figures for the nine-year-old boys showed that 91.7 per cent of the differences between observed stature at nine years and stature predicted for nine years from observed stature at seven years were not in excess of ±1.5 cm. The mean error of pre-

diction over this two-year age span, disregarding signs, was found to be .75 cm. For only two boys was the error of prediction at nine years greater than 2.0 cm.; in one instance the estimated-minus-observed residual was +2.4 cm. while in the other instance it was —2.1 cm.

The mean error of the 263 stature predictions at eleven years of age from stature observations at seven years of age, signs being disregarded, was found to be 1.07 cm.[7] Ninety-five per cent of the predictions over this four-year span were not in error more than ±2.5 cm. The maximum error of prediction was 3.7 cm. Expressed in relation to the standard deviation of the distribution for stature at eleven years, the mean error of prediction for the 263 boys was equivalent to 0.17 sigma and the largest error of prediction equalled 0.6 sigma.

CONCLUSION AND COMMENT

The findings reported above appear to justify the conclusion that the T-score or percentile technique furnishes a reasonably refined instrument for predicting the stature of the individual North European male of the public school population throughout his elementary school years. If a zone is allowed for the influence of differential health conditions and other factors which may modify growth in stature, the T-score technique would seem to be a highly accurate method of predicting "expected stature" for the age period and type of population here studied.

REFERENCES

1. MEREDITH, HOWARD V.: The Rhythm of Physical Growth: A Study of Eighteen Anthropometric Measurements on Iowa City White Males Ranging in Age between Birth and Eighteen Years. Univ. Iowa Stud., Stud. in Child Welfare, 1935, 11, No. 3. Pp. 128.
2. LINCOLN, EDWARD A.: Methods and results in the Harvard growth study. Reprint from *Harvard Teach. Rec.*, February, 1935. Pp. 10.
3. DEARBORN, WALTER F.: The mental and physical development of public school children. *School & Soc.*, 1935, 41, 585-593.
4. MCCALL, WILLIAM A.: How to Measure in Education. Macmillan: *New York*, 1922. Pp. xii, 416. (Chapter X, pp. 272-306)

[7]The Pearson product-moment coefficient of correlation between observed stature at seven years and observed stature at eleven years was +.975 for these 263 North European males.

RECENT LITERATURE

USEFUL IN THE STUDY OF HUMAN BIOLOGY

In this department will be noticed the books and reprints which are currently received at the Editorial Office. Publications intended for notice here should be addressed to Dr. Raymond Pearl, Department of Biology, School of Hygiene and Public Health, 1901 East Madison Street, Baltimore, Maryland, U. S. A.

I. EVOLUTION AND GENETICS

1. *Evolution—General Principles*

CHADWICK, GEORGE H. Summary of Upper Devonian stratigraphy. *American Midland Naturalist*, Vol. 16, pp. 857-862, 1935.

CUÉNOT, L. L'Espèce. *Paris* (Gaston Doin et Cie), 1936. Pp. 310. 8⅛ × 6 inches. 30 francs (paper). [Bibliography of 17 pages].

DOBZHANSKY, TH. A critique of the species concept in biology. *Philosophy of Science*, Vol. 2, pp. 344-355, 1935.

KEMPERMANN, CARL T. Am Wendepunkt der Stammesgeschichte. *Jena* (Gustav Fischer), 1936. Pp. 32. 9¼ × 6¼ inches. 1.50 marks (paper). [Bibliographic footnotes].

ROMER, ALFRED S., and BRANDON H. GROVE. Environment of the Early Vertebrates. *American Midland Naturalist*, Vol. 16, pp. 805-856, 1935. [Bibliographic footnotes].

SHULL, A. FRANKLIN. Weismann and Haeckel: One hundred years. *Science*, Vol. 81, pp. 443-452, 1935.

2. *Human Evolution*

ADLOFF, P. Art- und Rassenmerkmale im Gebiss des fossilen Menschen. *Zeitschrift für Rassenkunde*, Bd. 3, pp. 10-26, 1936. [Bibliography of 35 titles].

WEINERT, HANS. Eine Wiederherstellung des Pithecanthropus-Schädels auf Grund der Calotte von Trinil. *Zeitschrift für Rassenkunde*. Bd. 2, pp. 90-92, 1936.

3. *Prehistory and Archaeology*

[Vacant]

4. *Genetics—General Principles*

ALLEN, CHARLES E. The course and significance of sexual differentation. *Transactions of the Wisconsin Academy of Sciences, Arts and Letters*, Vol. 29, pp. 195-202, 1935.

CAULLERY, MAURICE, Les Conceptions Modernes de l'Hérédité. *Paris* (Ernest Flammarion), 1935. Pp. 312. 7½ × 5 inches. 15 francs (paper). [Bibliographic footnotes].

GÜNTHER, HANS. Die Variabilität der Organismen und ihre Normgrenzen. Zugleich ein kurzer Leitfaden der Variationsstatistik. *Leipzig* (Georg Thieme), 1935. Pp. 132. 9¾ × 6¾ inches. 7 marks (paper). [Bibliography of 5½ pages].

SHUTTLEWORTH, FRANK K. The nature *versus* nurture problem. Part I. Definition of the problem. *Journal of Educational Psychology*, Vol. 26, pp. 561-578, 1935.

SHUTTLEWORTH, FRANK K. The nature *versus* nurture problem. Part II. The contributions of nature and nurture to individual differences in intelligence. *Journal of Educational Psychology*, Vol. 26, pp. 655-681, 1935. [Bibliographic footnotes].

ŚLIŻYŃSKI, B. M. Chromosomalna koncepcja nowotworów. The Genetic Conception of Tumour. *Travaux du Laboratoire de Zootechnie Spéciale de l'Université Jagellonne*, Rok 1935/36, Nr. 23, pp. (of reprint) 7. [Bibliography of 13 titles]. [Summary in English].

WATKINS, ARTHUR E. Heredity and Evolution. *London* (John Murray), 1935. Pp. viii + 243 + 2 plates. 7¾ × 5⅛ inches. 7s. 6d. net. [Bibliography at end of several chapters and general bibliography of 15 titles].

5. *Human Heredity*

BUSCHKE, FRANZ. Röntgenologische Skelettstudien an menschlichen Zwillingen und Mehrlingen. Ein Beitrag zu den Problemen der Konstitution und der Phylogenese. Foreword by H. R. Schinz. *Fortschritte auf dem Gebiete der Röntgenstrahlen, Ergänzungsband* 46. *Leipzig* (Georg Thieme), 1934. Pp. 47 + 50 plates. 12 × 8½ inches. 25 marks (paper). [Bibliography of 2½ pages].

DAVIDENKOV, S. N. Problema Polimorfizma Nasledstvennykh Boleznieĭ Nervnoĭ Sistemy. [Polymorphismal Problems of Hereditary Diseases of the Nervous System]. *Leningrad* (Union Institute for Experimental Medicine), 1934. Pp. 139. [Bibliography of 40 titles]. [In Russian with German summary].

FISCHER, EUGEN. Kreuzung mit Chinesen in Europa! *Der Erbartz*, 1935, No. 7, pp. 101 ff.

FISCHER, EUGEN. Rasseneinteilung und Erbanalyse. *Zeitschrift für Rassenkunde*, Bd. 2, pp. 121-123, 1935. [2 bibliographic footnotes].

KLEIN, W.: Edited under the auspices of Berliner Akademie für ärztliche Fortbildung, by. Wer ist erbgesund und wer ist erbrank? Praktische Ratschläge für Durchführung des Gesetzes "zur Verhütung erbkranken Nachwuchses" und zur Verleihung der Ehrenpatenschaft. *Jena* (Gustav Fischer), 1935. Pp. xviii + 215. 9¾ × 6⅛ inches. 6.50 marks (paper); 8 marks (cloth).

LEHMANN, WOLFGANG. Einige Erblichkeitsfragen in der Kinderklinik. *Archiv für Kinderheilkunde*, Bd. 106, pp. 193-200, 1935. [Bibliography of 9 titles].

LEHMANN, WOLFGANG. Zwillingspathologische Untersuchungen über die dystrophische Diathese. *Zeitschrift für induktive Abstammungs- und Vererbungslehre*, Bd. 70, pp. 472-476, 1935. [Bibliography of 4 titles].

LEHMANN, WOLFGANG, and FRITZ KUHLMANN. Röntgenologische Untersuchungen an rachitischen Zwillingen. *Klinische Wochnschrift*, Jahrg. 15, pp. 50-52, 1936. [Bibliography of 6 titles].

RIFE, D. CECIL. Twin differences in intelligence. *Journal of Educational Psychology*, Vol. 26, pp. 709-712, 1935. [Bibliography of 3 titles].

SANDERS, J. Eine Familie mit Myotonia Congenita (Thomsen'sche Krankheit). *Genetica*, Vol. 17, pp. 253-269 + folding plate, 1935. [Bibliography of 21 titles].

SANDERS, J. Two families with albinismus circumscriptus. *Genetica*, Vol. 17, pp. 185-190 + 2 plates, 1935.

SJÖGREN, TORSTEN. Investigations of the heredity of psychoses and mental deficiency in two North Swedish parishes. *Annals of Eugenics*, Vol. 4, pp. 253-318 + 5 folding charts and tables, 1935. [Bibliograhy of 77 titles].

STRÖER, W. F. H. Familiäres Auftreten von Hand- und Fuss-Abweichungen in fünf Generationen. *Genetica*, Vol. 17, pp. 299-312 + 3 plates, 1935. [Bibliography of 10 titles].

SUK, V. Anthropological aspects of blood grouping. *Publications de la Faculté des Sciences de l'Université Masaryk*, No. 195. Pp. 9. 9 × 6 inches. [1 bibliographic footnote].

TAO, YUN-KUEI. Chinesen-Europäerinnen-Kreuzung. *Zeitschrift für Morphologie und Anthropologie*, Bd. 33, pp. 349-408 + 25 plates, 1935. [Bibliography of 53 titles].

WERNER, M. Zwillingsphysiologische Untersuchungen über den Grundumsatz und die spezifisch-dynamische Eiweisswirkung. *Zeitschrift für induktive Abstammungs- und Vererbungslehre*, Bd. 70, pp. 467-471, 1935. [Bibliography of 5 titles].

6. *Eugenics*

FISCHER, EUGEN. Das Erbgut der Sippen. *Mein Heimatland*, Heft 11/12, pp. 357-365, 1935.

II. GROUP BIOLOGY

1. *Environment of Man*

BURGER, J. WENDELL, and STANLEY THOMAS. Tastes and odors in the Delaware River. *Journal of the American Water Works Association*, Vol. 26, pp. 120-127, 1934. [4 bibliographic footnotes].

FRENZEL, GERHARD. Untersuchungen über die Tierwelt des Wiesenbodens. *Jena* (Gustav Fischer), 1936. Pp. v + 130. 9¼ × 6¼ inches. 6 marks (paper). [Bibliography of 157 titles].

LUMBY, J. R. Salinity and Temperature of the English Channel. Atlas of Charts. *Ministry of Agriculture and Fisheries, Fishery Investigations, Series*

II, Vol. XIV, No. 3. *London* (His Majesty's Stationery Office), 1935. 27 charts. 21 × 15 inches. 1 shilling, postage extra (paper).

LUMBY, J. R. Salinity and Temperature of the English Channel. Estimation of Mean Values for the Upper Water Layer over the 25-Year Period 1903 to 1927. *Ministry of Agriculture and Fisheries, Fishery Investigations, Series II*, Vol. XIV, No. 3. *London* (His Majesty's Stationery Office), 1935. Pp. 67 + 3 charts + 83 pp. tables. 10⅝ × 7¼ inches. 7 shillings, postage extra (paper). [Bibliography of 41 titles].

RIGHTS, F. L., and W. J. GODKIN. Bacteriological analyses of chlorinated and dechlorinated water samples from swimming pools. *Lehigh University Publications*, Vol. 10, No. 1, *The Institute of Research, Circular No. 116, Science and Technology*, No. 97. Pp. 12. [2 bibliographic footnotes].

SCHOENICHEN, WALTHER. Urdeutschland. Deutschlands Naturschutzgebiete in Wort und Bild. Lieferungen 13, 14. *Neudamm* (J. Neumann), 1935. Lief. 13, pp. 1-24 + 9 plates; Lief. 14, pp. 25-49 + 9 plates. 10¾ × 8¼ inches. 2 marks each (paper).

THOMAS, STANLEY, and J. WENDELL BURGER. Chlamydomonas in storage reservoirs. *Journal of the American Water Works Association*, Vol. 25, pp. 991-998, 1933. [10 bibliographic footnotes].

UNION OF SOUTH AFRICA, Office of Census and Statistics, Pretoria. Report of the Agricultural and Pastoral Production of the Union of South Africa, 1933-34. Agricultural Census, No. 14, 1934. *Pretoria* (Government Printer), 1936. Pp. 36. 13 × 8¼ inches. 2s. 6d. (paper). [In Dutch and English].

WAKSMAN, SELMAN A. Humus. Origin, Chemical Composition, and Importance in Nature. *Baltimore* (Williams and Wilkins Co.), 1936. Pp. xi + 494. 9 × 5⅞ inches. $6.50. [Bibliography of 1311 titles].

2. *Public Health and Hygiene*

AMERICAN ASSOCIATION OF MEDICAL MILK COMMISSIONS. The Facts About Certified Milk. *1265 Broadway, New York*, 1936. Pp. 15. 9 × 6 inches.

CH'EN, C. C. The rural public health experiment in Ting Hsien, China. *Milbank Memorial Fund Quarterly*, Vol. 14, pp. 66-80, 1936.

DOWNES, JEAN. Measuring the effectiveness of a tuberculosis program. *Milbank Memorial Fund Quarterly*, Vol. 14, pp. 50-56, 1936. [1 bibliographic footnote].

FAUGHT, FRANCIS A. Health examinations. The relation of the nurse to periodic health examinations and life extension. *American Journal of Nursing*, June, 1927, pp. (of reprint) 4.

FAUGHT, FRANCIS A. A practical method of periodic health examination. *Atlantic Medical Journal*, May, 1927, pp. (of reprint) 8.

FAUGHT, FRANCIS A. What the periodic health examination should disclose. *Weekly Roster and Medical Digest*, Vol. 30, No. 41, pp. (of reprint) 4, 1935.

HORWOOD, MURRAY P. Training for public health administration. Is a medical degree a primary prerequisite? *Technology Review*, Vol. 38, pp. (of reprint) 4, 1936.

DE KRUIF, PAUL, in collaboration with RHEA DE KRUIF. Why Keep Them Alive? *New York* (Harcourt, Brace and Co.), 1936. Pp. 293. 8½ × 5⅝ inches. $3.00.

MAJOR, RALPH H. Disease and Destiny. Preface by Logan Clendening. *New York* (D. Appleton-Century Co.), 1936. Pp. xiv + 338 + 37 plates. 8 × 5½ inches. $3.50.

PARRAN, THOMAS, JR. Syphilis control in New York State. *Milbank Memorial Fund Quarterly*, Vol. 14, pp. 57-65, 1936.

RANDALL, MARIAN G. Can the public health nurse evaluate her own activities? *Public Health Nursing*, January 1936, pp. (of reprint) 7. [1 bibliographic footnote].

RUSSELL, A. J. H. Annual Report of the Public Health Commissioner with the Government of India for 1933. Volume I with Appendices. *New Delhi* (Government of India Press), 1935. Pp. ix + 400 + 12 plates. 9¾ × 6½ inches. Rs. 6 As. 4 or 10 s. (paper).

SCAMMAN, C. L. Administrative aids to rural health service. *Milbank Memorial Fund Quarterly*, Vol. 14, pp. 13-22, 1936. [1 bibliographic footnote].

SYDENSTRICKER, EDGAR. Economy in public health. *Milbank Memorial Fund Quarterly*, Vol. 14, pp. 3-12, 1936.

UNION DES CAISSES D'ASSURANCES SOCIALES DE LA RÉGION PARISIENNE. Les Caisses d'Assurances Sociales et la Lutte contre le Péril Vénérien. *Numéro Spécial, Paris*, February 1936. Pp. 48. 10½ × 8½ inches. 4 francs (paper).

WIEHL, DOROTHY G. Measuring health needs in an urban district. *Milbank Memorial Fund Quarterly*, Vol. 14, pp. 23-36, 1936. [1 bibliographic footnote].

WILSON, G. S. Assisted by R. S. Twigg, R. C. Wright, C. B. Hendry, M. P. Cowell and I. Maier. The Bacteriological Grading of Milk. *Medical Research Council Special Report Series* No. 206. *London* (His Majesty's Stationery Office), 1935. Pp. 392. 9½ × 6 inches. 7s. 6d. net. [Bibliography of 8 pages].

YALE UNIVERSITY, SCHOOL OF MEDICINE. Contributions from the Anna M. R. Lauder Department of Public Health, Volume XIV, 1933-1935. [Collection of reprints].

3. *Migration*

HRDLIČKA, ALEŠ. Melanesians and Australians and the Peopling of America. *Smithsonian Miscellaneous Collections*, Vol. 94, No. 11. (Publication 3341). *Washington* (Smithsonian Institute), 1935. Pp. 58. 9⅝ × 6⅜ inches. 25 cents (paper). [Bibliography of 10 pages].

KOCH, H. Die Abwanderung der Begabten vom Dorf. Eine Untersuchung des Schicksals der guten und schlechten Schulkinder eines mitteldeutschen Dorfes auf Grund der Schulleistungen in den eingesessenen Familien im Zeitraum 1899-1934. *Zeitschrift für Rassenkunde*, Bd. 3, pp. 37-46. [1 bibliographic footnote].

PEARSE, A. S. The Migrations of Animals from Sea to Land. *Durham, N. C.* (Duke University Press), 1936. Pp. x + 176. 8½ × 5½ inches. $3.00. [Bibliography of 44 pages].

4. *Population*

BALÁS, CHARLES. Malthus and the population problems of to-day. *Journal de la Société Hongroise de Statistique*, No. 4, pp. (of reprint) 39, 1936.

COLD SPRING HARBOR Symposia on Quantitative Biology. Vol. III. *Cold Spring Harbor, Long Island, N. Y.* (Biological Laboratory), 1935. Pp. xv + 359. 10¾ × 7¾ inches. $3.75. [Bibliographies throughout].

DUBLIN, LOUIS I. The Population Problem and World Depression. *Foreign Policy Pamphlets* No. 1. *New York* (Foreign Policy Assoc.), 1936. Pp. 32. 8½ × 5⅜ inches. 25 cents (paper). [Bibliographic footnotes].

FISCHER, EUGEN. Erbarzt und Bevölkerungswissenschaft. *Der Erbarzt*, 1935, No. 8, pp. 113 ff.

GAUSE, G. F. Studies on the struggle for existence in mixed populations. *Zoological Journal* [Russian], T. 14, pp. 243-270, 1935. [Bibliography of 17 titles]. [In Russian with English summary].

GAUSE, G. F., and A. A. WITT. Behavior of mixed populations and the problem of natural selection. *American Naturalist*, Vol. 69, pp. 596-609, 1935. [Bibliography of 7 titles].

HJORT, JOHAN. Human activities and the study of life in the sea. An essay on methods of research and experiment. *American Geographical Review*, Vol. 25, pp. 529-564, 1935. [29 bibliographic footnotes].

HJORT, JOHAN, J. LIE, and JOHAN T. RUUD. Pelagic whaling in the Antarctic. V. The season 1934-1935. *Hvalrådets Skrifter, Scientific Results of Marine Biological Research*, No. 12, pp. 5-52 + 2 plates, 1935. [2 bibliographic footnotes].

KEYS, ANCEL, E. H. CHRISTENSEN, and AUGUST KROGH. The organic metabolism of sea-water with special reference to the ultimate food cycle in the sea. *Journal of the Marine Biological Association of the United Kingdom*, Vol. 20, pp. 181-196, 1935. [Bibliography of 23 titles].

KUCZYNSKI, ROBERT R. The Measurement of Population Growth. Methods and Results. *New York* (Oxford University Press), 1936. Pp. vi + 255. 8½ × 5⅜ inches. $4.00. [Bibliographic footnotes].

PARK, THOMAS. Studies in population physiology. V. The oxygen consumption of the flour beetle, *Tribolium confusum* Duval. *Journal of Cellular and Comparative Physiology*, Vol. 7, pp. 313-323, 1936. [Bibliography of 13 titles].

PEARL, RAYMOND. War and Overpopulation. *Current History*, Vol. 43, pp. 589-594, 1936.

SMITH, HARRY S. The rôle of biotic factors in the determination of population densities. *Journal of Economic Entomology*, Vol. 28, pp. 873-898, 1935. [Bibliography of 16 titles].

5. *Mortality and General Vital Statistics*

CRAMÉR, H., and H. WOLD. Mortality variations in Sweden. A study in graduation and forecasting. *Skandinavisk Aktuarietidskrift* 1935, pp. 161-241. [Bibliography of 35 titles].

DEPARTMENT OF COMMERCE, BUREAU OF THE CENSUS. Number of deaths (exclusive of stillbirths) from all causes: 1920 to 1934. Death rates per 1,000 estimated population: 1920 to 1933. *Vital Statistics, Special Reports*, Vol. 1, pp. 15-21, 1936.

DEPARTMENT OF COMMERCE, BUREAU OF THE CENSUS. Deaths (exclusive of stillbirths) from each cause, by age, sex, and color or race, in the Registration States of 1920 (including District of Columbia): 1934. *Vital Statistics, Special Reports*, Vol. 1, pp. 55-107, 1936.

DIVISION OF VITAL STATISTICS. Deaths (exclusive of stillbirths) in Continental United States from selected causes, by age and sex: 1934. *Vital Statistics, Special Reports, Washington, D. C.* (Bureau of the Census), Vol. 1, No. 3, pp. 9-13, 1936.

DROGENDIJK, ARIE C. De Verloskundige Voorziening in Dordrecht van ± 1500 tot heden. *Amsterdam* (H. J. Paris), 1935. Pp. xv + 353. 9½ × 6¾ inches. [Bibliography of 195 titles].

DUNN, HALBERT L. Announcement of New Series—Vital Statistics—Special Reports. *Vital Statistics, Special Reports, Washington, D. C.* (Bureau of the Census), Vol. 1, No. 1, p. 1, 1936.

DUNN, HALBERT L. Development of Vital Statistics in the Bureau of the Census. *Vital Statistics, Special Reports, Washington, D. C.* (Bureau of the Census), Vol. 1, No. 2, pp. 3-8, 1936.

INSTITUTE OF ACTUARIES and THE FACULTY OF ACTUARIES IN SCOTLAND; Published on behalf of. Continuous Investigation into the Mortality of Assured Lives. Monetary Tables A 1924-29. Vol. I, Vol. II, Vol. III (Joint Lives). *Cambridge* (The University Press); *New York* (The Macmillian Co.), 1935. Pp. (Vol. I) xxxix + 339; (Vol. II) x + 225; (Vol. III) x + 99. 9¾ × 6 inches. Vol. I, $22.50; Vol. II, $17.50; Vol. III, $11.00.

MARYLAND STATE BOARD OF HEALTH. Annual Report for the Year Ending December 31, 1934. *Baltimore*, 1936. Pp. 235 + 4 folding tables. 9⅛ × 6 inches.

MINER, JOHN R. Review of "Mortality Among Patients with Mental Disease," by Benjamin Malzberg. *Journal of the American Statistical Association*, Vol. 30, pp. 777-778, 1935.

REGISTRAR-GENERAL'S Statistical Review of England and Wales for the Year 1933. (New Annual Series, No. 13). Text. *London* (His Majesty's Stationery Office), 1935. 9⅝ × 6 inches. Pp. vi + 199. 3s. 6d. net (paper).

REGISTRAR-GENERAL'S Statistical Review of England and Wales for the Year 1934. (New Annual Series, No. 14). Tables. Part II. Civil. *London* (His Majesty's Stationery Office), 1936. Pp. iv + 152. 9⅝ × 6 inches. 2s. 6d. net (paper).

6. *Morbidity and Epidemiology*

DOWNES, JEAN. How tuberculosis spreads in a rural community. *American Journal of Public Health*, Vol. 26, pp. 30-36, 1936. [Bibliography of 2 titles].

GEAR, H. S. The age, sex, and monthly distribution of hospital patients in China. Chinese Medical Association hospital survey. *Chinese Medical Journal*, Vol. 49, pp. 160-175, 1935. [Bibliography of 10 titles].

GEAR, H. S. The incidence of tumors, benign and malignant, in hospital patients in China. *Chinese Medical Journal*, Vol. 49, pp. 261-272, 1935. [Bibliography of 11 titles].

GEAR, H. S. The incidence of venereal diseases in hospital patients in China. *Chinese Medical Journal*, Vol. 49, pp. 1122-1135, 1935. [Bibliography of 10 titles].

GEAR, H. S. Tuberculosis in China: Incidence of the various types. *Chinese Medical Journal*, Vol. 49, pp. 446-464, 1935. [Bibliography of 17 titles].

GEAR, H. S., and H. PEDERSEN. Some diseases common to man and animals in China. *Transactions Ninth Congress, Far East. Association Tropical Medicine, Nanking*, 1934, 2, pp. 305-323. [Bibliography of 65 titles].

MALZBERG, BENJAMIN. A statistical study of mental diseases among native of foreign white parentage in New York State. *Psychiatric Quarterly*, Vol. 10, pp. 127-142, 1936. [Bibliography of 3 titles].

MCKINLEY, EARL B. A Geography of Disease. A Preliminary Survey of the Incidence and Distribution of Tropical and Certain Other Diseases. *Washington* (The George Washington University Press), 1935. Pp. xxv + 495. 10 × 6¾ inches. $5.00.

NEW YORK TUBERCULOSIS AND HEALTH ASSOCIATION, INC. The Report for the year 1934. Pp. 60. 9 × 6 inches. *386 Fourth Ave., New York*, 1935.

WHEELER, RALPH E. Epidemiology of whooping cough in a rural area. *Milbank Memorial Fund Quarterly*, Vol. 14, pp. 81-91, 1936. [8 bibliographic footnotes].

7. *Natality, Fecundity, Fertility*

FROMMOLT, G. Rassefragen in der Geburtshilfe und Gynäkologie. *Leipzig* (Johann Ambrosius Barth), 1936. Pp. v + 96. 9⅛ × 6¼ inches. 5 marks (paper). [Bibliography of 7 pages].

LÖSCH, AUGUST. Was ist vom Geburtenrückgang zu halten? 1, 2. *Heidenheim* (*Wurtt.*) (Dr. August Lösch), 1932. Pp. (1) 73; (2) 95. 9 × 6 inches. 4.40 marks (paper). [Bibliography of 29 titles].

MURPHY, T. F.: Prepared under the supervision of. Birth, Stillbirth, and Infant Mortality Statistics for the Continental United States, the Territory of Hawaii, the Virgin Islands, 1933. Nineteenth Annual Report. U. S. Department of Commerce, Bureau of the Census. *Washington* (U. S. Government Printing Office), 1936. Pp. iv + 217. 11½ × 9 inches. $1.50.

NOTESTEIN, FRANK W. The fertility of populations supported by public relief. *Milbank Memorial Fund Quarterly*, Vol. 14, pp. 37-49, 1936. [7 bibliographic footnotes].

PEARL, RAYMOND. Birth rate in recent years. *The World Today, Encyclopaedia Britannica*, Vol. 3, pp. 27-29, 1935. [Bibliography of 2 titles].

TAUSSIG, FREDERICK J. Abortion—Spontaneous and Induced. Medical and Social Aspects. *St. Louis* (The C. V. Mosby Co.), 1936. Pp. 536. 9¾ × 6¾ inches. [Bibliography of 24 pages].

8. *Birth Control*

SUTHERLAND, HALLIDAY. Laws of Life. *New York* (Sheed and Ward), 1936. Pp. v + 270. 7¼ × 5 inches. $2.50. [Bibliographic footnotes].

9. *Marriage and Divorce*

[Vacant]

III. BEHAVIOR

1. *Racial and Genetic Psychology*

BUYTENDIJK, F. J. J. The Mind of the Dog. Translated by Lilian A. Clare. *Boston* (Houghton Mifflin Co.), 1936. Pp. 213 + 20 plates. 8 × 5¼ inches. $2.50.

VON EICKSTEDT, EGON FRHR. Grundlagen der Rassenpsychologie. *Stuttgart* (Ferdinand Enke), 1936. Pp. 164. 9 × 5¾ inches. 5.49 marks (paper); 6.80 marks (cloth). 25 per cent reduction outside of Germany. [Bibliographic footnotes].

TOMILIN, MICHAEL I., and ROBERT M. YERKES. Chimpanzee twins: behavioral relations and development. *Journal of Genetic Psychology*, Vol. 46, pp. 239-263, 1935. [Bibliography of 10 titles]. [Summary in French and German].

YERKES, ROBERT M., and ADA W. YERKES. Social behavior in infra-human primates. *A Handbook of Social Psychology*, Chap. 21, pp. 973-1033, 1935. [Bibliography of 36 titles].

YERKES, ROBERT M., and MICHAEL I. TOMILIN. Mother-infant relations in chimpanzee. *Journal of Comparative Psychology*, Vol. 20. pp. 321-359, 1935. [Bibliography of 17 titles].

2. *Individual Psychology*

BRILL, MOSHE. The reliability of the Goodenough Draw a Man test and the validity and reliability of an abbreviated scoring method. *Journal of Educational Psychology*, Vol. 26, pp. 701-708, 1935. [10 bibliographic footnotes].

CLARK, WALTER H. Two tests for perseverance. *Journal of Educational Psychology*, Vol. 26, pp. 604-610, 1935. [1 bibliographic footnote].

FERGUSSON, HARVEY. Modern Man. His Beliefs and Behavior. *New York* (Alfred A. Knopf), 1936. Pp. viii + 331 + v. 8 × 5⅜ inches. $2.75. [Bibliography of 3 pages].

FINCH, F. H. Sex differences in mental growth. *Journal of Educational Psychology*, Vol. 26, pp. 623-628, 1935. [Bibliography of 10 titles].

LAMP, CHARLES J. Can aptitude for special musical instruments be predicted? *Journal of Educational Psychology*, Vol. 26, pp. 587-596, 1935. [Bibliography of 7 titles].

REED, HOMER B. An experiment on the law of effect in learning the maze by humans. *Journal of Educational Psychology*, Vol. 26, pp. 695-700, 1935.

3. *Psychiatry*

ANDROP, SERGE. The Probability of Commitment for a Mental Disorder of Any Kind Based on the Individual's Family History. *Monograph Series Number X. Cold Spring Harbor, Long Island, N. Y.* (Eugenics Research Assoc.), 1935. Pp. vi + 79. 9 × 6 inches. 50 cents (paper). [Bibliography of 14 titles].

ASSOCIATION FOR RESEARCH IN NERVOUS AND MENTAL DISEASE. Editorial Board: Clarence A. Patten, Angus M. Frantz, Clarence C. Hare. Sensation: Its Mechanisms and Disturbances. An Investigation of the Most Recent Advances. The Proceedings of the Association, New York, December 27th and 28th, 1934. *Baltimore* (Williams and Wilkins Co.), 1935. Pp. xxiii + 541. 9 × 6 inches. $7.50. [Bibliography at the end of each paper].

MALZBERG, BENJAMIN. Mental disease among foreign-born whites, with special reference to natives of Russia and Poland. *American Journal of Psychiatry*, Vol. 92, pp. 627-640, 1935. [Bibliography of 17 titles].

ZIEGLER, LLOYD H., and JACOB HEYMAN. False concepts of diseases or conditions as psychogenic foci. *American Journal of Psychiatry*, Vol. 92, pp. 655-673, 1935. [Bibliography of 5 titles].

4. *History and Biography*

AMERICAN LIBERTY LEAGUE. The Story of an Honest Man. What happened to Major General Johnson Hagood when, at the request of a Congressional Committee, he dared to speak the truth as he saw it. *Document No. 107. Washington* (American Liberty League), 1936. Pp. 10. 9 × 4 inches.

BARTLETT, KATHARINE. Hopi History, No. 2. The Navajo Wars—1823-1870. *Museum Notes (Museum of Northern Arizona)*, Vol. 8, pp. 33-37, 1936. [Bibliography of 9 titles].

BESTERMAN, THEODORE [Complied by]. A Bibliography of Sir James George Frazer, O. M. *New York* (The Macmillan Co.), 1934. Pp. xxi + 100 + 3 plates. 8½ × 5⅜ inches. $4.50.

BUTLER, NICHOLAS MURRAY. Andrew Carnegie, Benefactor. *International Conciliation*, No. 315, pp. 531-538, December 1935.

CIOCCO, ANTONIO. The historical background of the modern study of constitution. *Bulletin of the Institute of the History of Medicine*, Vol. 4, pp. 23-38, 1936. [Bibliography of 49 titles].

EDELSTEIN, LUDWIG. Nachträge (Hippocrates). *Paulys Realenzyklopädie der Klassischen Altertumswissenschaft*, pp. 1290-1343. *Stuttgart* (J. B. Metzlersche Verlagsbuchhandlung), 1934.

EDELSTEIN, LUDWIG. Winckelmann and the translation of Dioscurides. *Bulletin of the Institute of the History of Medicine*, Vol. 4, pp. 261-263, 1936. [Bibliographic footnotes].

FULTON, JOHN F. A Bibliography of Two Oxford Physiologists, Richard Lower 1631-1691, John Mayow, 1643-1679. *Oxford Bibliographic Society Proceedings and Papers, Vol. IV, Part I. i*, 1934. *Oxford* (Oxford University Press), 1935. Pp. 62 + 6 plates. 10¼ × 7½ inches. 10 shillings (paper).

GREGORY, WILLIAM K. Henry Fairfield Osborn. *Science*, Vol. 82, pp. 452-454, 1935.

GREGORY, WILLIAM K. Henry Fairfield Osborn; An Appreciation. *Scientific Monthly*, Vol. 41, pp. 566-569, 1935. [Portrait].

JAFFE, BERNARD. Outposts of Science. Journey to the Workshops of Our Leading Men of Research. *New York* (Simon and Schuster), 1935. Pp. xxvi + 547. 9¼ × 6 inches. $3.75. [Bibliography of 12½ pages].

LARKEY, SANFORD V. The Hippocratic oath in Elizabethan England. *Bulletin of the Institute of the History of Medicine*, Vol. 4, pp. 201-219, 1936. [Bibliographic footnotes].

LARKEY, SANFORD V. Rare books in the Welch Medical Library. 1. Conrad Gesner's copy of the Aphorisms of Hippocrates, Basel, 1547. *Bulletin of the Institute of the History of Medicine*, Vol. 4, pp. 61-64, 1936.

[LUMIÈRE, AUGUSTE]. Nomenclature des Principaux Travaux Scientifiques Publiés par Auguste Lumière, 1887-1935. *Lyon* (Léon Sézanne), 1935. Pp. 47. 8¼ × 5⅜ inches.

MANHATTAN MEDICAL SOCIETY. Past, Present and Future Activities of the Manhattan Medical Society. A brief review of major events and a forecast. *Pamphlet* No. 3. *New York*, 1935. Pp. 53. 11 × 8½ inches.

MILLER, GENEVIEVE. Unpublished autographs in the Welch Medical Library. 1. An autograph of Thomas Martyn. *Bulletin of the Institute of the History of Medicine*, Vol. 4, pp. 243-246, 1936. [Bibliographic references].

OLIVER, JOHN R. An unpublished autograph letter from Dr. John Crawford (1748-1813) to General William Henry Winder (1775-1824). *Bulletin of the Institute of the History of Medicine*, Vol. 4, pp. 145-151, 1936.

PEARSON, KARL. Old Tripos days at Cambridge as seen from another viewpoint. *Mathematical Gazette*, Vol. 20, pp. 27-36, 1936.

PENNIMAN, T. K. A Hundred Years of Anthropology. *New York* (The Macmillan Co.), 1936. Pp. 400. 8½ × 5⅜ inches. $4.50. [Bibliography of 22 pages].

SHOUSE, JOUETT. Seventeen Months of the American Liberty League. *Document No. 96. Washington* (American Liberty League), 1936. Pp. 11. 9 × 4 inches.

SIGERIST, HENRY E. An autograph note of Louis Pasteur. *Bulletin of the Institute of the History of Medicine*, Vol. 4, pp. 153-157 + plate; 1936. [Bibliographic footnotes].

SIGERIST, HENRY E. A 15th century text on the medicinal virtues of madder (*Rubia tinctorum*). *Bulletin of the Institute of the History of Medicine*, Vol. 4, pp. 57-60, 1936. [Bibliographic footnotes].

SIGERIST, HENRY E. The history of medicine and the history of science. An open letter to George Sarton, editor of *Isis*. *Bulletin of the Institute of the History of Medicine*, Vol. 4, pp. 1-13, 1936.

TEMKIN, OWSEI. Epilepsy in an anonymous Greek work on acute and chronic diseases. *Bulletin of the Institute of the History of Medicine*, Vol. 4, pp. 137-144, 1936. [Bibliographic footnotes].

TEMKIN, OWSEI. Rare books in the Welch Medical Library. 2. Old manuscript prescriptions in a copy of Celsus, Venice, 1497. *Bulletin of the Institute of the History of Medicine*, Vol. 4, pp. 159-164, 1936. [Bibliographic footnotes].

TEMKIN, OWSEI. Recent publications on Egyptian and Babylonian medicine. *Bulletin of the Institute of the History of Medicine*, Vol. 4, pp. 247-256, 1936. [Bibliographic footnotes].

VIGNE, PAUL. L'Oeuvre Scientifique d'Auguste Lumière dans le Domaine de la Biologie et de la Médecine. *Lyon* (Léon Sézanne), 1931. Pp. 31. 9½ × 6¼ inches.

WASSERBERG, I. An essay on charlatanism. *Quarterly Bulletin of the Health Organisation, League of Nations*, Vol. 4, pp. 555-617, 1935. [Bibliographic footnotes].

ZIRKLE, CONWAY. The Beginnings of Plant Hybridization. *Philadelphia* (University of Pennsylvania Press), 1935. Pp. xiii + 231 + 8 plates. $2.50. [Bibliography of 16 pages].

5. *Sociology, Law, Politics and Religion*

AMERICAN LIBERTY LEAGUE. Alternatives to the American Form of Government. An Examination of Three European Dictatorships Whose Underlying Theories Bear upon Present Attempts to Regiment Industry and Agriculture in the United States. *Document No.* 81. *Washington* (American Liberty League), 1935. Pp. 14. 9 × 4 inches.

AMERICAN LIBERTY LEAGUE. A Program for Congress. Some Suggestions and Recommendations Designed to Encourage the Legislative Branch of the Government to Reassert Its Constitutional Prerogatives and Put the Nation's House in Order. *Document No.* 83. *Washington*, 1935. Pp. 23. 9 × 4 inches.

[ANONYMOUS]. "An Expert on International Affairs." Sanctions in the Italo-Ethiopian conflict. *International Conciliation*, No. 315, pp. 539-544, 1935.

BLEDSOE, SAMUEL T. The challenge of the times. Founders Day Address, *Washington and Jefferson College*, November 16, 1935. Pp. 15. 9 × 6 inches.

CAROTHERS, NEIL. Time to Stop. *Document No.* 94. *Washington* (American Liberty League), 1936. Pp. 9. 9 × 4 inches.

CARSON, JAMES M. The Constitution and the New Deal. *Document No.* 89. *Washington* (American Liberty League), 1936. Pp. 23. 9 × 4 inches.

COMMITTEE OF THE NATIONAL PEACE CONFERENCE: Report of a. A study of neutrality legislation. With an introduction by James T. Shotwell. *International Conciliation*, No. 316, pp. 3-61, 1936.

DAVIS, JOHN W. The Constitution. What It Means to the Man in the Street. *Document No.* 100. *Washington* (American Liberty League), 1936. Pp. 8. 9 × 4 inches.

DAVIS, JOHN W. The Redistribution of Power. *Document No.* 93. *Washington* (American Liberty League), 1936. Pp. 20. 9 × 4 inches.

DAWSON, CHARLES I. The President Has Made the Issue. *Document No.* 95. *Washington* (American Liberty League), 1936. Pp. 14. 9 × 4 inches.

DESVERNINE, RAOUL E. Americanism at the Crossroads. *Document No.* 88. *Washington* (American Liberty League), 1936. Pp. 21. 9 × 4 inches.

DESVERNINE, RAOUL E. The Real Significance of the Constitutional Issue. *Document No.* 82. *Washington* (American Liberty League), 1935. Pp. 21. 9 × 4 inches.

DOLLARD, JOHN. Criteria for the Life History. With Analysis of Six Notable Documents. Published for the Institute of Human Relations. *New Haven* (Yale University Press), 1935. Pp. v + 288. 9 × 6 inches. $2.50. [Bibliographic footnotes].

ELKIND, HENRY B., and MAURICE TAYLOR. The evaluation of juvenile courts and clinics. *American Journal of Orthopsychiatry*, Vol. 5, pp. 217-226, 1935. [7 bibliographic footnotes].

FOX, LEON A. Bacterial warfare. The use of biologic agents in warfare. *The Military Surgeon*, Vol. 72, No. 3, pp. (of reprint) 18, 1933. [Bibliography of 2 titles]. *Washington* (U. S. Government Printing Office). 5 cents (paper).

FOX, LEON A. The basic biologic aspect of war. *The Military Surgeon*, Vol. 78, pp. 22-31, 1936.

HATCHER, JOHN H. The Power of Federal Courts to Declare Acts of Congress Unconstitutional. *Document No.* 104. *Washington* (American Liberty League), 1936. Pp. 20. 9 × 4 inches. [Bibliographic footnotes].

HOOVER, HERBERT. The Confused State of the Union. *420 Lexington Ave., N. Y.* (Edgar Rickard), 1936. Pp. 12. 9 × 4 inches.

HOOVER, HERBERT. The New Deal further explored—including relief. *420 Lexington Ave., N. Y.* (Edgar Rickard), 1935. Pp. 23. 7 × 3¾ inches.

HOUGHTON, N. D. The present status of the League of Nations. *International Conciliation*, No. 317, February 1936, pp. 67-108. [Bibliographic footnotes].

LENROOT, KATHARINE F. National aspects of the Social Security program as they pertain to the Children's Bureau. *American Journal of Public Health*, Vol. 25, pp. 1327-1333, 1935.

MAXEY, GEORGE W. What the Constitution Means to the Citizen. *Document No.* 106. *Washington* (American Liberty League), 1936. Pp. 21. 9 × 4 inches.

MCDOUGALL, WILLIAM. Religion and the Science of Life. With Other Essays on Allied Topics. *Durham, N. C.* (Duke University Press), no date. Pp. xiii + 263. 7¼ × 5 inches. $3.00.

NEEDHAM, JOSEPH. Order and Life. *New Haven* (Yale University Press), 1936. Pp. x + 175. 8 × 5⅜ inches. $2.50. [91 bibliographic footnotes].

PEARL, RAYMOND. Biology and human progress. *Harper's Magazine*, Vol. 172, pp. 225-235, 1936.

PEFFER, NATHANIEL. The fallacy of conquest. *International Conciliation*, No. 318, pp. 121-131, 1936.

REED, JAMES A. The Constitution—the Fortress of Liberty. *Document No.* 105. *Washington* (American Liberty League), 1936. Pp. 14. 9 × 4 inches.

RITCHIE, ALBERT C. The American Form of Government—Let Us Preserve It. *Document No.* 92. *Washington* (American Liberty League), 1936. Pp. 11. 9 × 4 inches.

ROSSO, AUGUSTO. Italy's conflict with Ethiopia. *International Conciliation*, No. 315, pp. 545-552, 1935.

SHOUSE, JOUETT. Arousing Class Prejudices. *Document No.* 84. *Washington* (American Liberty League), 1935. Pp. 7. 9 × 4 inches.

SHOUSE, JOUETT. Shall We Plow Under the Supreme Court? *Document No.* 101. *Washington* (American Liberty League), 1936. Pp. 19. 9 × 4 inches.

SIGERIST, HENRY E. L'inquiétude actuelle dans le monde médical. *Schweizerische Medizinische Wochenschrift*, Jahrg. 65, Nr. 42, pp. (of reprint) 12, 1935.

STINCHFIELD, FREDERICK H. The American Constitution—Whose Heritage? The Self-Reliant or Those Who Would Be Wards of the Government? *Document No.* 90. *Washington* (American Liberty League), 1936. Pp. 19. 9 × 4 inches.

TCHERNAVIN, TATIANA. We Soviet Women. Translated by N. Alexander. *New York* (E. P. Dutton and Co.), 1936. Pp. 304. 8 × 5½ inches. $2.50. [Portrait].

TECLÉ-HAWARIATE, P. Report of the Council under Article 15, paragraph 4, of the Covenant. Submitted by the Committee of the Council on October 5, and Adopted by the Council on October 7, 1935. [Reprinted from League of Nations Document C. 411 (1). M. 207 (1). 1935. VII. Geneva, October 7, 1935]. *International Conciliation*, No. 315, pp. 553-597, 1935.

WARBURG, JAMES P. What of 1936? *Document No.* 87. *Washington* (American Liberty League), 1936. Pp. 15. 9 × 4 inches.

WATSON, THOMAS J. International peace. *International Conciliation*, No. 318, pp. 132-136, 1936.

6. *Economics*

AMERICAN LIBERTY LEAGUE. Professors and the New Deal. A Compendium of Quotations Demonstrating that a Great Majority of the Nation's Educators Believe in Sound Principles of Economics and Constitutional Theories of Government. *Document No.* 91. *Washington*, 1936. Pp. 23. 9 × 4 inches.

AMERICAN LIBERTY LEAGUE. The Townsend Plan. An Analysis of an Attempt to Perpetrate a Cruel Hoax upon a Trusting People. *Document No.* 102. *Washington*, 1936. Pp. 15. 9 × 4 inches.

AMERICAN LIBERTY LEAGUE. Wealth and Income. A Factual Analysis of a Situation Frequently Obscured by Misinformation and Attempts to Arouse Class Prejudices. *Document No.* 98. *Washington*, 1936. Pp. 19. 9 × 4 inches.

CROWTHER, SAMUEL. The Only Real Security. An Interview with Henry Ford. *The Deserted Village No.* 7. *American Political Economy. New York* (Chemical Foundation), 1936. Pp. 24. 7½ × 5 inches.

EDIE, LIONEL D. The Mysteries of Recovery. *New York* (Edie-Davidson), 1936. Pp. 15. 7½ × 5 inches.

FAUGHT, FRANCIS A. Economic value of the periodic health examination. *Pennsylvania Medical Journal*, January, 1933, pp. (of reprint), 13.

HOOVER, HERBERT. Further Explorations of the New Deal—Including Agricultural Policies. *420 Lexington Ave., N. Y.* (Edgar Rickard), 1936. Pp. 12. 9 × 4 inches.

KEMMERER, EDWIN W. Inflation and Our Gold Reserve. *Document No.* 103. *Washington* (American Liberty League), 1936. Pp. 9. 9 × 4 inches.

MCTIGUE, CHARLES H., Secretary. State of New York Annual Report of the State Tax Commission, 1934. *Legislative Document* (1935), No. 11. *Albany.* Pp. 363. 8¾ × 5¾ inches.

MINER, JOHN R. The cost of biological books in 1935. *Quarterly Review of Biology,* Vol. 10, pp. 492-493, 1935.

MOULTON, HAROLD G. Economic progress without economic revolution. *Fortune,* Vol. 12, pp. 77-81, 1935.

SMITH, ALFRED E. The Facts in the Case. *Document No.* 97. *Washington* (American Liberty League), 1936. Pp. 19. 9 × 4 inches.

SMITH, H. P., D. T. KILLOUGH, D. L. JONES, and M. H. BYROM. Progress in the Study of the Mechanical Harvesting of Cotton. *Bulletin No.* 511. *College Station* (Texas Agricultural Experiment Station), 1935. Pp. 35. 9 × 6 inches.

SONDERN, FREDERICK E. Medicine and men. A discussion of compulsory sickness insurance. *New York State Journal of Medicine,* by permission of the *1935-1936 Debate Handbook.* Pp. (of reprint) 12.

WESTERFIELD, RAY B. The Townsend Utopia. *Document No.* 99. *Washington* (American Liberty League), 1936. Pp. 14. 9 × 4 inches.

WILLKIE, WENDELL L. The Public Utility Problem. Its Recent History and Possible Solution. *New York* (Commonwealth and Southern Corp.), 1935. Pp. 22. 8¼ × 5¼ inches.

7. *Education*

BACHMAN, GEORGE W. Report of the Director of the School of Tropical Medicine of The University of Puerto Rico under the auspices of Columbia University, for the Year Ending June, 1935. Pp. 66. 9 × 6 inches.

BROWN, W. STERRY. Science—Education—Good Citizenship. *Box 145, Bloomington, Ill.* Pp. 8. 9½ × 5⅞ inches.

GULEKE, J. O. Federal Encroachment upon the Field of Education in Texas. *Washington* (American Liberty League), 1935. Pp. 10. 9 × 4 inches.

RIDDLE, OSCAR. The confusion of tongues. *Science,* Vol. 83, pp. 41-45, 69-74, 1936.

8. *Ethnology, Cultural Anthropology, Travel and Exploration*

ALCOBÉ, S. Die Eurafrikaniden und die Rassengliederung der Iberischen Halbinsel. *Zeitschrift für Rassenkunde,* Bd. 3, pp. 30-36, 1936. [Bibliography of 34 titles].

BERNATZIK, HUGO A. South Seas. Translated from the German by Vivian Ogilvie. *New York* (Henry Holt and Co.), 1935. Pp. xiv + 167 + 103 plates. 9 × 6 inches. $3.50.

HAGLUND, SVEN. Life Among the Lapps. On the Spring Trek with The Köngämä Lapps. Translated from the Swedish by William Savage. *London* (Denis Archer), 1935. Pp. 252. 8½ × 5½ inches. 12s. 6d. net.

HOLDEN, W. C., C. C. SELTZER, R. A. STUDHALTER, C. J. WAGNER and W. G. MCMILLAN. Studies of the Yaqui Indians of Sonora, Mexico. *Texas Technological College Bulletin*, Vol. XII, No. 1. *Scientific Series* No. 2. *Lubbock* (Texas Technological College), 1936. Pp. 142. 9 × 6 inches. 60 cents postpaid (paper).

JUNGE, J. Frühgeschichte der ostindogermanischen Śaken. *Zeitschrift für Rassenkunde*, Bd. 3, pp. 68-77, 1936. [Bibliographic footnotes].

KROGMAN, WILTON M. The "New Deal" for the American Indian. *Zeitschrift für Rassenkunde*, Bd. 3, pp. 77-81, 1936.

LYELL, DENIS D. [Edited and Annotated by]. African Adventure. Letters from Famous Big-Game Hunters. *New York* (E. P. Dutton and Co.), 1935. Pp. xv + 270 + 8 plates. 8½ × 5½ inches. $3.75.

NESBITT, L. M. Desolate Marches. Travels in the Orinoco Llanos of Venezuela. *New York* (Harcourt, Brace and Co.), 1936. Pp. 320. 8 × 5¼ inches. $2.50.

SZÉCHENYI, COUNT ZSIGMOND. Land of Elephants. Big-Game Hunting in Kenya, Tanganyika and Uganda. *London* (Putnam and Co.), 1935. Pp. xi + 209 + 96 plates. 8½ × 5½ inches. 12s. 6d. net.

IV. SOMATOLOGY AND CONSTITUTION

1. *Anatomy*

BARLOW, RALPH N. The sternalis muscle in American whites and negroes. *Anatomical Record*, Vol. 61, pp. 413-426, 1935. [Bibliography of 16 titles].

BÖKER, HANS. Einführung in die vergleichende biologische Anatomie der Wirbeltiere. Erster Band. *Jena* (Gustav Fischer), 1935. Pp. xi + 228. 10¼ × 6¾ inches. 12 marks (paper); 13.50 marks (cloth). [Bibliography of 6 pages].

BRACHET, A. Traité d'Embryologie des Vertébrés. Second edition revised and completed by A. Dalcq and P. Gérard. *Paris* (Masson et Cie), 1935. Pp. viii + 690. 9½ × 6½ inches. 110 francs (paper); 130 francs (cloth). [Bibliography at the end of each chapter].

CHARLES, C. M. On the menisci of the knee joint in American whites and negroes. *Anatomical Record*, Vol. 63, pp. 355-364, 1935. [Bibliography of 6 titles].

EDGEWORTH, F. H. The Cranial Muscles of Vertebrates. *Cambridge* (University Press); *New York* (The Macmillan Co.), 1935. Pp. x + 493. 12¾ × 9¼ inches. $30.00. [Bibliography of 8 pages].

LLOYD, LEO W. The renal artery in whites and American negroes. *American Journal of Physical Anthropology*, Vol. 2, pp. 153-163, 1935. [Bibliography of 15 titles].

NGOMYANG, G. Über Rassengehirne. *Zeitschrift für Rassenkunde*, Bd. 3, pp. 26-30, 1936. [Bibliography of 31 titles].

RICHARDS, A., and A. I. ORTENBURGER. Practical Comparative Embryology. *St. Louis* (John S. Swift Co.), 1935. Pp. 112. 11 × 8½ inches. $1.45 (paper).

SEIB, GEORGE A. Incidence of the patent foramen ovale cordis in adult American whites and American negroes. *American Journal of Anatomy*, Vol. 55, pp. 511-525, 1934. [Bibliography of 15 titles].

STREETER, GEORGE L. Annual report of the Director of the Department of Embryology, Carnegie Institution of Washington. *Year Book No. 34*, for the year 1934-35, pp. 8-36, 1936.

TEITELBAUM, HARRY A. The innervation of the thyroid gland. *Bulletin of the School of Medicine, University of Maryland*, Vol. 18, pp. 77-91, 1934. [Bibliography of 46 titles].

TERRY, R. J. Review of *"Revision Anatomica del Sistema Arterial,"* by Pedro Belou. *Anatomical Record*, Vol. 63, pp. 317-322, 1935.

WILLIAMS, GEORGE D., and HENRY W. EDMONDS. Variations in the arrangement of the branches arising from the aortic arch in American whites and negroes (a second study). *Anatomical Record*, Vol. 62, No. 2 and Supplement, pp. 139-146, 1935. [Bibliography of 7 titles].

WOLFF, DOROTHY. Significant anatomic features of the auditory mechanism with special reference to the late fetus. *Annals of Otology, Rhinology and Laryngology*, Vol. 42, No. 4; Vol. 43, No. 1, pp. (of reprint) 91, 1933-1934 [Bibliography of 3 pages].

2. *Physical Anthropology and Anthropometry*

BOLDRINI, MARCELLO. La stratificazione sociale dei difetti fisici. *Contributi del Laboratorio di Statistica, Università Cattolica del Sacro Cuore, Serie Quarta, Statistica*, Vol. 9, pp. 273-296, 1936. [Bibliographic footnotes]. [Abstract in French, English, and German].

BUSSE, HERTA. Altslawische Skelettreste im Potsdamer Havelland. *Zeitschrift für Ethnologie*, 66. Jahrg., pp. 111-128, 1934. [Bibliography of 12 titles].

DESBAROLLES, ADOLPHE. Die Hand und ihre Geheimnisse. *München-Planegg* (Otto Wilhelm Barth), 1935. Pp. 313. 8⅝ × 5½ inches. 6 marks (paper); 7.50 marks (cloth). [14 pages of notes and bibliography].

KLENKE, WERNER. Der ober- und der niederschlesische Gautypus. (Nach Studentenuntersuchungen). *Zeitschrift für Rassenkunde*, Bd. 3, pp. 56-68, 1936. [22 bibliographic footnotes].

LEBZELTER, V. Bemerkungen über rassenkundliche Untersuchungen. *Zeitschrift für Rassenkunde*, Bd. 3, pp. 88-89, 1936.

MENGARELLI, CARLO. Su i caratteri fisici della nobilità. *Contributi del Laboratorio di Statistica, Università Cattolica del Sacro Cuore, Serie Quarta, Statistica*, Vol. 9, pp. 239-271 + 3 folding tables, 1936. [Bibliographic footnotes]. [Abstract in French, English and German].

MIYAKE, SOETSU. Bericht über die Anthropologische Forschung in Japan 1934. *Zeitschrift für Rassenkunde*, Bd. 3, pp. 82-84, 1936.

PRICE, WESTON A. Studies of relationships between nutritional deficiencies and (a) facial and dental arch deformities and (b) loss of immunity to dental caries among South Sea Islanders and Florida Indians. *Dental Cosmos*. November 1935, pp. 1033-1045. [Bibliography of 2 titles].

ROTH, OTTO. Wachstumsversuche an Ratten. Ein Beitrag zur Frage der Entstehung der Schädelform. *Zeitschrift für Morphologie und Anthropologie*, Bd. 33, pp. 409-439 + 2 folding tables, 1935. [Bibliography of 32 titles].

SCHEBESTA, PAUL, and VICTOR LEBZELTER. Anthropologie Středoafrických Pygmejů v Belgickém Kongu. (Anthropology of the Central African Pygmies in the Belgian Congo). *Prague* (Czech Academy of Sciences and Arts), 1933. Pp. 144 + 56 plates. 14¼ × 10½ inches.

SCHULTZ, BR. K., and M. HESCH. Rassenkundliche Bestimmungs-Tafeln für Augen-, Haar- und Hautfarben und für die Iriszeichnung. *München* (J. F. Lehmann), no date. 3 colored and 1 black and white chart, in folder. 6¾ × 5½ inches.

SCHWIDETZKY, I. Weitere Methoden zur Kontrolle der v. Eickstedtschen Rassenformeln. *Zeitschrift für Rassenkunde*, Bd. 3, pp. 46-55, 1936. [2 bibliographic footnotes].

SUK, V. Fallacies of anthropological identifications and reconstructions. A critique based on anatomical dissection. *Publications de la Faculté des Sciences de l'Université Masaryk*, No. 207. Pp. 18. 9 × 6 inches. [Bibliography of 16 titles].

TROTTER, MILDRED. The activity of hair follicles with reference to pregnancy. *Surgery, Gynecology and Obstetrics*, Vol. 60, pp. 1092-1095, 1935.

WHITACRE, JESSIE. Seasonal variations of growth in weight and height of Texas school children. *Texas Agricultural Experiment Station Bulletin* No. 510. *College Station*, 1935. Pp. 72. 8¾ × 6 inches.

3. *Constitution*

BOLDRINI, MARCELLO. Tipi e attitudini costituzionali e costituzione delle aristocrazie. *Contributi del Laboratorio di Statistica, Università Cattolica del Sacro Cuore, Serie Quarta, Statistica*, Vol. 9, pp. 1-77, 1936. [Note by A. Uggè, "Sul tipo morfologico degli atleti", pp. 65-76]. [Bibliography of 35 titles].

BOLDRINI, MARCELLO, and ALDO ALBERTI. Il patriziato italiano nelle categorie dirigenti. *Contributi del Laboratorio di Statistica, Università Cattolica del Sacro Cuore, Serie Quarta, Statistica*, Vol. 9, pp. 183-238, 1936. [Bibliography of 10 titles]. [Abstract in French, English and German].

COSTANZO, ALESSANDRO. Costituzione e Mortalità. *Pubblicazioni della Università Cattolica del Sacro Cuore, Serie Ottava, Statistica*, Vol. 10. *Milano*, 1936. Pp. ix + 187 + 2 folding tables. 10 × 6½ inches. 15 lire. [Abstracts in French, English and German].

FANFANI, AMINTORE. I mutamenti economici nell'Europa moderna e l'evoluzione costituzionalistica delle classi dirigenti. *Contributi del Laboratorio di Statistica, Università Cattolica del Sacro Cuore, Serie Quarta, Statistica*, Vol. 9, pp. 137-155, 1936. [Bibliographic footnotes]. [Abstract in French, English and German].

MAGGI, RAFFAELLO. La costituzione degli attori dello schermo. *Contributi del Laboratorio di Statistica, Università Cattolica del Sacro Cuore, Serie Quarta, Statistica*, Vol. 9, pp. 79-136, 1936. [Bibliographic footnotes]. [Abstract in French, English and German].

MENGARELLI, CARLO. I caratteri costituzionali delle aristocrazie italiane. *Contributi del Laboratorio di Statistica, Università Cattolica del Sacro Cuore, Serie Quarta, Statistica*, Vol. 9, pp. 157-182, 1936. [Bibliographic footnotes]. [Abstract in French, English and German].

RITTERSHAUS, ERNST. Konstitution oder Rasse? *Munich* (J. F. Lehmann), 1936. Pp. 209. 9 × 6 inches. In Germany: 7.40 marks (paper), 8.80 marks (cloth). Outside Germany: 5.55 marks (paper), 6.60 marks (cloth). [Bibliography of 6 pages].

V. PHYSIOLOGY AND BIOCHEMISTRY

1. *Physiology*

AMERICAN MEDICAL ASSOCIATION, COUNCIL ON PHARMACY AND CHEMISTRY [Prepared under Auspices of]. Glandular Physiology and Therapy. A Symposium. *Chicago* (American Medical Assoc.), 1935. Pp. vi + 528. 8¾ × 5½ inches. $2.50. [Bibliographic footnotes throughout].

CALEWAERT, D. Essai pour une Conception Physique de la Vie. *Paris* (Librairie Maloine), 1935. Pp. 78. 7½ × 5¼ inches.

CRILE, GEORGE. The Phenomena of Life. A Radio-Electric Interpretation. *New York* (W. W. Norton and Co.), 1936. Pp. 379. 8½ × 5¾ inches. $3.50. [Bibliography at the end of each chapter].

HALSTEAD, WARD. The Effects of Cerebellar Lesions upon the Habituation of Post-Rotational Nystagmus. *Comparative Psychology Monographs*, Vol. 12, No. 1, Serial No. 56. *Baltimore* (Johns Hopkins Press), 1935. Pp. 130. 10 × 6⅞ inches. $1.75. [Bibliography of 85 titles].

HARDY, SIR WILLIAM BATE. Collected Papers. Published under the auspices of the Colloid Committee of the Faraday Society. *Cambridge* (University Press); *New York* (The Macmillan Co.), 1935. Pp. x + 384 + 14 plates. 10¼ × 7 inches. [Bibliographic footnotes].

HEALTH ORGANISATION, LEAGUE OF NATIONS. Report of the second conference on the standardisation of sex hormones, held in London, July 15th to 17th, 1935. *Quarterly Bulletin of the Health Organisation, League of Nations*, Vol. 4, pp. 618-630, 1935. [1 bibliographic footnote].

KATZENELBOGEN, SOLOMON. The Cerebrospinal Fluid and Its Relation to the Blood. A Physiological and Clinical Study. *Baltimore* (Johns Hopkins Press), 1935. Pp. xix + 468. 9 × 6 inches. $5.00. [Bibliography of 43 pages].

LANGDON-BROWN, SIR WALTER. The Integration of the Endocrine System. Being the Fifth Horsley Memorial Lecture, Delivered at University Hospital Medical School. *Cambridge* (University Press); *New York* (The Macmillan Co.), 1935. Pp. 54. 7¼ × 4⅞ inches. 75 cents (paper). [Bibliography of 33 titles].

LIGHT, J. S., and W. HORSLEY GANTT. Essential part of reflex arc for establishment of conditioned reflex. Formation of conditioned reflex after exclusion of motor peripheral end. *Journal of Comparative Psychology*, Vol. 21, pp. 19-36, 1936. [Bibliography of 13 titles].

LOUCKS, ROGER B. The experimental delimitation of neural structures essential for learning: The attempt to condition striped muscle responses with faradization of the sigmoid gyri. *Journal of Psychology*, Vol. 1, pp. 5-44, 1936. [Bibliography of 26 titles].

LUMIÈRE, AUGUSTE. La Renaissance de la Médecine Humorale. *Lyon* (Léon Sézanne), 1935. Pp. xi + 204. 8½ × 5¼ inches.

MITTASCH, ALWIN. Über Katalytische Verursachung im biologischen Geschehen. *Berlin* (Julius Springer), 1935. Pp. x + 126. 8½ × 5¾ inches. 5.70 marks (paper). [Bibliography of 4 pages].

RICHARDS, OSCAR W. Analysis of the constant differential growth ratio. *Carnegie Institution of Washington Publication* No. 452, pp. 171-183, 1935. [27 bibliographic footnotes].

RICHARDS, OSCAR W. Systematic variation in the human menstrual interval. *American Journal of the Medical Sciences*, Vol. 190, No. 5 pp. (of reprint) 9, 1935. [Bibliography of 10 titles].

RIDDLE, OSCAR, and ROBERT W. BATES. Chemical basis of sex. *Encyclopaedia Sexualis*, 1936, pp. (of reprint) 10.

2. *Senescence, Senility and Longevity*

DUBLIN, LOUIS I., and ALFRED J. LOTKA. Length of Life. A Study of the Life Table. *New York* (Ronald Press), 1936. Pp. xxii + 400. 8⅜ × 5¾ inches. $5.00. [Bibliography of 34 titles].

FAUGHT, FRANCIS A. Characteristic findings after forty years of age. *Medical Record*. October 3, 1934, pp. (of reprint) 14.

KEYES, E. LAWRENCE. Anatomical observations on senile changes in the shoulder. *Journal of Bone and Joint Surgery*, Vol. 17, pp. 953-960, 1935. [Bibliography of 13 titles].

3. *Biochemistry*

ADAIR, G. S., and A. B. KEYS. A micro method for the determination of base by electro-dialysis. *Journal of Physiology*, Vol. 81, pp. 162-166, 1934. [Bibliography of 3 titles].

BATES, ROBERT W., and OSCAR RIDDLE. The preparation of prolactin. *Journal of Pharmacology and Experimental Therapeutics*, Vol. 55, pp. 365-371, 1935. [Bibliography of 9 titles].

EMBDEN, GUSTAV, and GERHARD SCHMIDT. Tätigkeitssubstanzen der quergestreiften Muskulatur. *Handbuch der biologischen Arbeitsmethoden*, Lief. 449, pp. 1505-1592, 1936. [Bibliography of 119 titles].

EMERSON, CHARLES P., and O. M. HELMER. Reaction (pH) and carbon dioxide content of the venous plasma in pernicious anemia. *Archives of Internal Medicine*, Vol. 55, pp. 254-261, 1935. [20 bibliographic footnotes].

FRANKLIN INSTITUTE. Reports of the Biochemical Research Foundation of the Franklin Institute (Formerly the Cancer Research Laboratories), Vol. III, 1934-1935. *Philadelphia*. 9¾ × 6¾ inches. [Collection of reprints].

GRIGNARD, V., and PAUL BAUD [Published under the direction of]. Traité de Chimie Organique. Tome III. Hydrocarbures Aliphatiques Saturés et Non Saturés. Longues Chaînes Cycliques. Cyclanes, Cyclènes et Terpènes Monocycliques. Dérivés Halogénés, Nitrosés ou Nitrés des Hydrocarbures Précédents. Industries Dérivées de l'Acétylène. Dérivés Chlorés Industriels. By J. Doeuvre, G. Dupont, V. Grignard, R. Lespieau, J. Lichtenberger, L. Palfray, L. Ruzicka, F. Swats. *Paris* (Masson et Cie), 1935. Pp. xix + 784. 10 × 6½ inches. 150 francs (paper); 170 francs (cloth). [Bibliography at end of each chapter].

HARRIS, LESLIE J. Vitamins in Theory and Practice. *Cambridge* (The University Press), *New York* (The Macmillan Co.), 1935. Pp. xix + 240 + plate. 8 × 6 inches.

HELMER, O. M. Vitamin B_1 and B_2 content of human urine. *Proceedings of the Society for Experimental Biology and Medicine*, Vol. 32, pp. 1187-1188, 1935. [1 bibliographic footnote].

HUME, E. MARGARET, and HARRIETTE CHICK [Edited by]. Reports on Biological Standards. IV. The Standardization and Estimation of Vitamin A. *Medical Research Council Special Report Series*, No. 202. 9⅝ × 6 inches. Pp. 61. 1 shilling net (paper). [Bibliography of 31 titles].

KEYS, ANCEL B. The carbon dioxide balance between the maternal and foetal bloods in the goat. *Journal of Physiology*, Vol. 80, pp. 491-501, 1934. [Bibliography of 28 titles].

KEYS, ANCEL, and R. M. HILL. The osmotic pressure of the colloids in fish sera. *Journal of Experimental Biology*, Vol. 11, pp. 28-34, 1934. [Bibliography of 29 titles].

KEYS, ANCEL, and HENRY TAYLOR. The behavior of the plasma colloids in recovery from brief severe work and the question as to the permeability of the capillaries to proteins. *Journal of Biological Chemistry*, Vol. 109. pp. 55-67, 1935. [Bibliography of 19 titles].

KEYS, ANCEL, and HENRY TAYLOR. The determination of the colloidal osmotic pressure in blood serum and similar fluids. *Journal of Biological Chemistry*, Vol. 109, pp. 47-53, 1935. [Bibliography of 13 titles].

KROGH, AUGUST, and ANCEL KEYS. Methods for the determination of dissolved organic carbon and nitrogen in sea water. *Biological Bulletin*, Vol. 67, pp. 133-144, 1934. [Bibliography of 8 titles].

LIESEGANG, RAPHAEL ED. Kolloid-Fibel für Mediziner. *Dresden and Leipzig* (Theodor Steinkopff), 1936. Pp. 34. 8¾ × 5½ inches. 1 mark (paper).

MITTASCH, ALWIN. Über katalytische Verursachung im biologischen Geschehen. *Berlin* (Julius Springer), 1935. Pp. x + 126. 8½ × 5¾ inches. 5.70 marks (paper). [27 pages of bibliography and notes].

ROBSCHEIT-ROBBINS, F. S., G. B. WALDEN, and G. H. WHIPPLE. Blood regeneration in severe anemia. Fractions of kidney, spleen and heart compared with standard liver fractions. *American Journal of Physiology*, Vol. 113, pp. 467-475, 1935. [Bibliography of 11 titles].

SCHMIDT, GERHARD. Mikrobestimmungen von Purinsubstanzen in Geweben. *Handbuch der biologischen Arbeitsmethoden*, Lief. 449, pp. 1593-1604, 1936. [Bibliographic footnotes].

TIAN, A., and J. ROCHE. Précis de Chimie. A l'Usage des Candidats au Certificat d'Études Physiques, Chimiques et Biologiques et a la Licence ès Sciences. *Paris* (Masson et Cie), 1935. Pp. viii + 970. 7⅝ × 5¼ inches. 80 francs.

4. *Pharmacology*

CHEN, K. K., and A. LING CHEN. The alkaloids of han-fang-chi. *Journal of Biological Chemistry*, Vol. 109, pp. 681-685, 1935. [Bibliography of 8 titles].

CHEN, K. K., A. LING CHEN and CHARLES L. ROSE. The action and toxicity of retrorsine. *Journal of Pharmacology and Experimental Therapeutics*, Vol. 54, pp. 299-305, 1935. [Bibliography of 6 titles].

GAUTIER, R. The health organisation and biological standardisation. *Quarterly Bulletin of the Health Organisation, League of Nations*, Vol. 4, pp. 497-554, 1935. [Bibliography of 31 titles].

SCHULZE, KONRAD. Die Herstellung und Prüfung homöopathischer Arzneimittel. Eine Anleitung für das Apothekenlaboratorium. With a foreword by Th. Sabalitschka. *Dresden* (Theodor Steinkopff), 1936. Pp. viii + 92. 8¾ × 5¾ inches. 4.50 marks (paper) [Bibliographic footnotes].

SOLLMAN, TORALD, NORA E. SCHREIBER, and H. N. COLE, in collaboration with J. V. AMBLER, J. A. GAMMEL, R. L. HOWARD, and H. C. SHAW. Excretion of mercury after clinical intramuscular and intravenous injections. *Archives of Dermatology and Syphilology*, Vol. 32, pp. 1-48, 1935. [13 bibliographic footnotes].

SWANSON, EDWARD E. The detoxification of strychnine by pentobarbital sodium. *Journal of the American Pharmaceutical Assoc.*, Vol. 26, pp. 959-961, 1935. [Bibliography of 7 titles].

VI. PATHOLOGY, CLINICAL MEDICINE AND SURGERY

BLACKLOCK, D. B., and T. SOUTHWELL. A Guide to Human Parasitology for Medical Practitioners. Second Edition. *Baltimore* (William Wood and Co.), 1935. Pp. viii + 259 +2 plates. 9¼ × 6 inches. $4.00.

BOLGERT, MARC. Lésions du Pancréas et Troubles Fonctionnels Pancréatiques. Diagnostic en Clinique par l'Épreuve a la Sécrétine Purifiée. Preface by G. Roussy. *Paris* (Masson et Cie), 1935. Pp. viii + 255. 9¾ × 6½ inches. 45 francs (paper). [Bibliography of 14 pages].

CHANDLER, ASA C. Introduction to Human Parasitology. Fifth Edition, Rewritten and Enlarged. *New York* (John Wiley and Sons), 1936. Pp. xvi + 661. 9 × 5¾ inches. $5.00. [Bibliography of 5½ pages].

COLEBROOK, DORA C. The Source of Infection in Puerperal Fever Due to Haemolytic Streptococci. *Medical Research Council Special Report Series*, No. 205. *London* (His Majesty's Stationery Office), 1935. Pp. 99. 9¾ × 6 inches. 1s. 6d. net (paper). [Bibliography of 36 titles].

FAUGHT, FRANCIS A. Blood pressure evaluation of the surgical risk from the internist's viewpoint. *Anesthesia and Analgesia*, September-October 1931, pp. (of reprint) 7.

FRANCIS, THOMAS, JR. Etiological and immunological aspects of influenza. *Health Examiner*, Vol. 5, pp. 13-16, 1936. [Bibliography of 10 titles].

FRANK, ROBERT T. Obesity: public enemy No. 1. *Health Examiner*, Vol. 5, pp. 7-10, 1935.

GREAVES, JOSEPH E., and ETHELYN O. GREAVES. Elementary Bacteriology. Third Edition, Reset. *Philadelphia* (W. B. Saunders Co.), 1936. Pp. 562. 7¾ × 5¼ inches. $3.50 net.

HURD, LEE M. Complications in epidemic infection of the upper respiratory tract. *Health Examiner*, Vol. 5, pp. 17-19, 1936.

IMPERIAL CANCER RESEARCH FUND. Thirty-Third Annual Report 1934-1935. *London*, 1935. Pp. 35. 9¾ × 7¼ inches.

KLEMPERER, PAUL. Pathology of influenza. *Health Examiner*, Vol. 5. pp. 7-12, 1936. [1 bibliographic footnote].

SPERANSKY, A. D. A Basis for the Theory of Medicine. Translated and Edited by C. P. Dutt with the Collaboration of A. A. Subkov. *New York* (International Publishers), no date. Pp. 452. 9 × 6 inches. [Bibliography of 9 titles].

VII. METHODOLOGY

1. *Mensurational and Observational*

GRASHEY, R. Röntgenuntersuchung der Knochen und Gelenke. *Handbuch der biologischen Arbeitsmethoden*, Lief. 449, pp. 1423-1446, 1936. [Bibliographic footnotes].

HARDY, J. I. A Practical Laboratory Method of Making Thin Cross Sections of Fibers. *U. S. Department of Agriculture Circular* No. 378. *Washington* (U. S. Government Printing Office), 1935. Pp. 10. 9 × 6 inches. 5 cents (paper). [6 bibliographic footnotes].

PETERS, H. B. Über Augenfarbentafeln und ihren diagnostischen Wert. *Zeitschrift für Rassenkunde*, Bd. 3, p. 87, 1936.

2. *Mathematical and Statistical*

CONRAD, HERBERT S. On the calculation of the correlation between a single element of a composite and the remainder of the composite. *Journal of Educational Psychology*, Vol. 26, pp. 611-615, 1935. [3 bibliographic footnotes].

HOLMES, MAURICE C. An Outline of Probability and Its Uses. *Ann Arbor, Mich.* (Edwards Bros.), 1936. Pp. viii + 119. 8¼ × 5¼ inches. $1.50 (paper). [Bibliography of 58 titles].

KULLBACK, SOLOMON. A note on Sheppard's correction. *Annals of Mathematical Statistics*, Vol. 6, pp. 158-159, 1935.

KULLBACK, SOLOMON. On the Bernoulli distribution. *Bulletin of the American Mathematical Society*, December 1935, pp. 857-864. [Bibliographic footnotes].

KULLBACK, SOLOMON. On samples from a multivariate normal population. *Annals of Mathematical Statistics*, Vol. 6, pp. 201-213, 1935. [Bibliographic footnotes].

LORIMER, FRANK. Adjustment for the influence of age composition on estimates by Burks's method of the distribution of sizes of completed fraternities. *Journal of the American Statistical Association*, Vol. 30, pp. 688-690, 1935.

NICEFORO, ALFREDO. Qualche recente, o nuovo, o poco usato tipo di rappresentazione grafica. *Barometro Economico Italiano*, 1935, pp. (of reprint) 13. [Bibliographic footnotes].

PRZYBOROWSKI, J., and H. WILEŃSKI. Statistical principles of routine work in testing clover seed for dodder. *Biometrika*, Vol. 27, pp. 273-292, 1935. [Bibliographic footnotes].

WISHART, J., and H. G. SANDERS. Principles and Practice of Field Experimentation. *London* (Empire Cotton Growing Corporation), 1935. Pp. 100. 9½ × 6 inches. 3 shillings (paper).

YATES, F. Complex experiments. *Supplement to the Journal of the Royal Statistical Society*, Vol. 2, pp. 181-223, 1935. [Discussion of paper, pp. 223-247]. [Bibliography of 8 titles].

YATES, F. Some examples of biased sampling. *Annals of Eugenics*, Vol. 6, pp. 202-213, 1935. [Bibliography of 3 titles].

3. *Other and General*

ASHER, LEON. Eine Kathodenstrahloszillographeneinrichtung für physiologische Zwecke. *Handbuch der biologischen Arbeitsmethoden*, Lief. 449, pp. 1465-1504, 1936. [Bibliographic footnotes].

DEPARTMENT OF COMMERCE, BUREAU OF THE CENSUS. Instructions to Coders of Causes of Death. *Vital Statistics, Special Reports, Washington, D. C.* (Bureau of the Census), Vol. 1, pp. 23-53, 1936.

KIESE, MANFRED. Methoden zur Untersuchung der glatten Muskulatur der Lunge. *Handbuch der biologischen Arbeitsmethoden*, Lief. 449, pp. 1447-1463, 1936. [Bibliographic footnotes].

RICHARDS, OSCAR W. A terminology proposed for motion picture films. *Science*, Vol. 82, pp. 102-103, 1935. [3 bibliographic footnotes].

RICHARDS, OSCAR W. [Chairman], B. EARL CLARKE, JEAN KIEFFER, K. K. BOSSE. Report of the Committee on Motion Pictures. *Journal of the Biological Photographic Assoc.*, Vol. 3, pp. 141-144, 1935.

ŠKERLJ, B. Eine graphische Darstellungsmethode der Verhältnisse des weiblichen Beckens. *Zeitschrift für Rassenkunde*, Bd. 3, p. 92, 1936.

WELLISCH, S. Zur Ausgestaltung der v. Eickstedtschen Rassenformeln. *Zeitschrift für Rassenkunde*, Bd. 3, pp. 89-90, 1936.

WÖHLISCH, EDGAR. Myothermische Schnellregistrierung mittels des Elektronenröhren-Mikrovoltmeters. *Handbuch der biologischen Arbeitsmethoden*, Lief. 449, pp. 1405-1422, 1936.

YERKES, ROBERT M. Yale Laboratories of Primate Biology, Incorporated. *Science*, Vol. 82, pp. 618-620, 1935.

VIII. GENERAL AND MISCELLANEOUS

ARON, M., and P. GRASSÉ. Précis de Biologie Animale. A l'Usage des Candidats au Certificat d'Études Physiques, Chimiques et Biologiques et a la Licence ès Sciences. *Paris* (Masson et Cie), 1935. Pp. viii + 1009. 7⅝ × 5¼ inches. 80 francs. [Bibliography of 36 titles].

COMMONWEALTH FUND. Seventeenth Annual Report, for the Year Ending September 30, 1935. *New York*, 1936. Pp. 89 + 8 plates. 9 × 6 inches.

EICKSTEDT, EGON FRHR. v. Ganzheits-Anthropologie. *Zeitschrift für Rassenkunde*, Bd. 3, pp. 1-10, 1936. [Bibliography of 24 titles].

FURNAS, C. C. The Next Hundred Years. The Unfinished Business of Science. *Baltimore* (The Williams and Wilkins Co.), 1936. Pp. xiv + 434. 8½ × 5½ inches. $3.00. [Bibliography of 6 pages].

LEAGUE OF NATIONS. Quarterly Bulletin of the Health Organisation, Volume IV, No. 3. *Boston and New York* (World Peace Foundation), 1935. Pp. 497-630. 9½ × 6¼ inches. 65 cents (paper).

MULLER, H. J. Out of the Night. A Biologist's View of the Future. *New York* (The Vanguard Press), 1935. Pp. 127. 7½ × 5 inches. $1.50.

SEIFRIZ, WILLIAM. Protoplasm. *New York* (McGraw-Hill Book Co.), 1936. Pp. x + 584. 9 × 6 inches. $6.00. [Bibliography of 23½ pages].

SPAULDING, EDWARD G. A World of Chance, or Whence, Whither, and Why? *New York* (The Macmillan Co.), 1936. Pp. xxxiii + 293. 8 × 5½ inches. $3.00.

UNIVERSITÀ CATTOLICA DEL SACRO CUORE. Contributi del Laboratorio di Statistica. Serie Quarta. Statistica, Vol. IX. *Milano* (Società Editrice "Vita e Pensiero"), 1936. Pp. 299. 10 × 6½ inches. Lire 20 (paper). [Abstract in French, English and German].